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I sometimes think of the story of
Peter Bamm, who was on a lovely island
where he met all kinds of people,
good and bad. He dreamt in a nightmare
that a bomb might come and destroy
everything, and the first thing that
occurred to him was what a pity it
would be for the butterflies.

Dietrich Bonhoeffer
Letters and Papers
From Prison

Atala
Communication of The Xerces Society
one. April, 1973

T H E X E R C E S S O C I E T Y

Here is your copy of Atala, the communication of the Xerces Society. The name of the newsletter refers to the Atala Hairstreak (Eumaeus atala) a brilliant butterfly of the Everglades region which is perhaps our most endangered butterfly. The name of the organization comes from one we have already lost--the Xerces Blue, the first known human-caused butterfly extinction in North America.

The Society has been formed to resist the destruction of butterfly populations on this continent and elsewhere. Toward this general objective, studies are underway to determine the most immediate needs. The protection of endangered populations is promulgated on two levels: On a continental scale, emulating such groups as the Nature Conservancy and the National Audubon Society, attention goes to endangered species, major subspecies and regional and continental rarities. Simultaneously, a highly decentralized, community-based movement sovers populations of local significance. Our program focuses the energies of the people, politically and financially, to effect proper land-use decisions by agencies and to acquire and manage habitat reserves. The protection of suitable habitat is the major front. Chemical pesticides and herbicides are addressed as potential hazards to butterfly populations. Except in rare instances, collecting of butterflies is not injurious to species; prudent, scientific collecting is certainly not condemned by the Society; but we discourage the mere acquisition of large numbers of wild butterflies.

While the Xerces Society works to conserve butterflies, the Xerces Institute will provide the scientific framework for the conservation program. Undertaking and utilizing studies in biogeography, autecology, systems ecology and re related fields, the Institute will enable the work of the Society to proceed on a sound conceptual basis. This body of professional and serious amateur researchers will also provide intellectual liaison between the conservation-and nature-minded public and the scientific, entomological arena. We hope that eventually the Xerces Institute will sponsor studies and employ its own battery of lepidopterists to work on special target problems.

MEMBERSHIP IN THE XERCES SOCIETY is open to anyone who shares the interests and goals of the group. Membership is conferred upon expression of that interest. There is as yet no set dues structure, but contributions are cordially solicited in lieu of dues. Members will receive Atala, which is published Occasionally, and other publications of the Society. Organizations, activities, how to help, officers and local groups are all discussed further in this issue.

This first number of Atala was produced by the Director. All inquiries, suggestions, comments and requests will gladly be accepted by him:

Robert M. Pyle, Director, The Xerces Society
(before September 1, 1973) College of Forest Resources
University of Washington
Seattle, Washington USA 98195
(after September 1, 1973) School of Forestry and Environmental Studies
Yale University, New Haven, Connecticut, USA.

Inquiries about the Society may also be directed to Jo Brewer, Associate Director, The Xerces Society, 300 Islington Road, Auburndale, Mass., USA 02166

MEMBERSHIP FORM
for
THE XERCES SOCIETY

Please check the appropriate sections and return, to Jo Brewer, Associate Director, The Xerces Society, 300 Islington Road, Auburndale, Mass., USA 02166.

---I am interested in butterflies and wish to help perpetuate rich, natural populations; enroll me as a member of the Xerces Society.

---I am aware of a particular local or regional situation and would like to be a focal person for the Society.

---I am an active research worker (amateur or professional) and would like to be named a Fellow of The Xerces Institute.

---I am interested in possibly attending the First World Conference on the Conservation of Lepidoptera.

Dues are voluntary. Donations are cordially solicited with your membership and anytime after, but are not required.

COMMENTS

"Butterflies matter to me."

Howard Ensign Evans
Life on a Little Known Planet

A LETTER FROM THE DIRECTOR

The Xerces Society happened on December 9, 1971, in London. I was fortunate enough to be spending a year with the British Nature Conservancy, studying the conservation of rare and endangered butterflies under the support of a U.S. Fulbright-Hays Fellowship. On that evening Mr. G. Howarth of the British Museum presented a lecture on conservation of the Large Blue butterfly before the British Entomological Society. He suggested that, if Maculinea arion should be lost in Great Britian, it should become a symbol for a determined effort to save all the other species.

It occurred to me then that our own Xerces Blue, the last colony of which was destroyed in San Francisco in the 1940's, might serve as such a symbol for a butterfly conservation movement in North America. I was intrigued with the possibilities. Rolling northward on British Rail that night, I conceived and outlined the Xerces Society.

In the ensuing year, Xerces has developed beyond my hopes -- and metamorphosis into a mature movement is imminent. People have come together, issues have been met, a reserve has been established and many energies have been consumed. A few butterflies have been saved. Many more face the bulldozer daily, however: And we need help. This first issue of Atala presents some of the ideas, people and events which have spurred Xerces so far; and suggests some projected futures for the Society.

So why butterflies? Except as minor pollenators and food for songbirds, butterflies do not appear to occupy any big eco-roles from which they would be missed, though we cannot be certain of that. No, the justification for spending time and money to conserve butterflies must be sought in the values and pleasures of the individual. I heard it expressed best by an English lad at a meeting of butterfly recorders: "Without butterflies, the world just wouldn't be as worth ~~liwng~~ living in."

Consider it. Isn't YOUR world richer for the butterflies in it?

I have been gratified and awed by the interest and cooperation of many people who think so. With your help, Xerces shall take wing again.

ANNOUNCING**

THE FIRST WORLD CONFERENCE ON THE CONSERVATION OF LEPIDOPTERA

June/July 1976 in the Pacific Northwest

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During his studies of butterfly conservation in Great Britain in 1971-72, the Director was able to make many contacts with Old World butterfly and moth people who share the views and concerns of the Xerces Society. Some of the countries had evolved sophisticated programs already, such as Great Britain; while others were just starting like us. But all the lepidopterists and conservationists with whom I spoke expressed a strong desire to get together with North Americans and others to discuss mutual problems from an international perspective. Our continent, with its great natural diversity and aggressive environmental movements, seemed like an appropriate setting. So the Xerces Society has begun planning for such a colloquium, to be held four years hence.

The symposium will convene in Washington State in the Pacific Northwest in late June of 1976 and will carry on for two weeks. The preliminary itinerary calls for papers and discussion centered on four different institutions of higher learning, each of which possesses an innovative or well developed program of studies, teaching and research in either environmental conservation or entomology. These are the University of Washington, Evergreen State College, Huxley College of Western Washington State College and Washington State University.Five days will be spent at the Lake Wilderness Continuing Education Center of the UW, near Seattle, interspersed with day trips to Mt. Rainier National Park and the city. Longer field trips and expeditions will introduce participants to various biomes and nature reserves throughout Washington State. The tour, by coach, will stop at the Rain Forest, wilderness coast and alpine areas of Olympic National Park and the vast mountain preserve in North Cascades National Park. National Forests, National Wildlife Refuges, Atomic Energy Commission Reserve, State Parks and Wildlife Recreation Areas, County and City Parks and private reserves will all be explored, and their significance as butterfly reserves interpreted by agency personnel. Lots of time for photography, exploring, informal relating and specimen collecting(limited in the reserves, of course) ;fun as well as work. The cost has not been set, but the Society hopes to be able to provide up to fifty full stipends for foreign conferees. The goal will be to share ideas, techniques and data, to erect a world policy and to establish a World Butterfly Protectorate. If you are interested in attending the conference, please write the Director as soon as possible. Participants from all parts of the world are urgently solicited, as the results can only be as complete and full as the representation. A pleasurable, fascinating and valuable experience is guaranteed.

getting it together with the Lepidopterists' Society

RENDEZVOUS IN SAN ANTONIO...

reflection on the meeting:

the brilliant pipe-vine swallowtails, the Texas sun, and the dinner on the San Antonio River(Mexican food, A-1) were worth the 20 take-offs and landings, even if nothing had happened in terms of butterfly-saving. But PLENTY DID happen in that regard, too!

The Lepidopterists" Society is the major international body concerned with butterflies and moths. A strong and close liaison between the Lep. Soc. and the Xerces Society is absolutely vital for the most effective development of butterfly conservation. So when the Director was invited to participate in a symposium on endangered and extinct Lepidoptera at the society's 25th Annual Meeting, the opportunity was not to be missed. The fact that the symposium was to be held in San Antonio, Texas, and the Director of Xerces was in England was certainly an obstacle, but one which proved surmountable. When the meeting convened on June 25, 1972, the Xerces rep was wilting in Texas, having left in a chilly fog. Unfortunately, John Heath,of the Nature Conservancy's Monks Wood Experimental Station, was unable to make it to Texas due to the lamentable international shortage of scientific funding. Thus the Director of Xerces represented the British contingent with a paper entitled "Pioneering Butterfly Conservation: The Monks Wood Studies"(see next issue of <u>Atala</u>). This was followed by an optimistic account of Project Ponceanus by Dr. Charles Covell (see p. 5). "Endangered and Extinct Lepidoptera of Coastal Dune Systems in California" was an enthralling but slightly terrifying talk presented by Dr. Jerry Powell. The moral was that butterflies and dune buggies don't get along too well in the same fragile dune systems. Discussion followed on Monarch wintering grounds, which, according to Dr. Patrick Wells largely unprotected; and on a rare moth scan being conducted by Sidney Hessel. Your Director took the podium again in the comfortable position of having last word. In "A Program for Conservation of North American Lepidoptera," he put forth the Xerces Society, its programs, goals and hopes. Response was encouraging, and the overwhelming feeling was that there would be a beautiful relationship growing between the two societies, thanks to Dr. C.L. Remington, who provided the interface by putting together and carrying out the symposium; Roy and Connie kendall for organizing the meeting, and 100 + folks for coming.
Kendall

...AND IN OAKLAND

This feeling of progressive alliance was perpetuated at the 19th Annual Meeting of the Pacific Slope Section of the Lepidopterists' Society in Oakland, California last September. Again a conservation symposium was held, this time chaired by Xerces Focal Person Jerry Powell. The papers: "Disturbance of Tropical Habitats," Herman G. Real; "Biotic Degradation in Central America," Gerald W. George; "Plant Community Reserves in Iowa," Stephen Miller; "Butterfly Conservation in the San Bruno Mountains," John F. Emmel; and "Rara and Endangered Status For Invertebrate Animals,"Eugene V. Coan. The latter paper noted that insects are <u>not</u> covered by the Federal Endangered Species Act. Finally, an important resolution was drafted at this meeting. See p. 5 for the text .

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H E A D L I N E S

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SOCIETY ENTERS MOVEMENT FOR AN OREGON COASTAL MEADOW RESERVE...
Chief Counsellor Dave McCorkle will be remembered by many members as the tireless educator-conservationist-scientist whose efforts led to The Nature Conservancy's Moxee Bog Reserve for the Silver-bordered Bog Fritillary (Boloria selene) in Washington State. McCorkle has since been most active with varied insect research in Oregon. His curious prowling brought to his attention the precarious situation of Speyeria zerene hippolyta. This rare coastal subspecies of the Zerene Fritillary is endemic to the a limited shore-edge meadow niche in the Pacific Northwest, and being so restricted may well be on its way to speciation. But this habitat is an extremely vulnerable and fragile one, being highly coveted for oceansidedevelopment, a fact which casts a menacing shadow over the future of this spectacular butterfly. On October 17, 1972, McCorkle wrote to the Director: "You will recall the proposed hippolyta reserve on the Oregon Coast. When I checked the spot late this summer, I found it posted with 'for sale' signs. I contacted the realtors and learned that a California firm is interested in its purchase, along with other nearby property, for a condominium! Obviously, I could delay no longer." McCorkle moved into action, contacting The Nature Conservancy and the Oregon Department of Parks and Recreation.

We decided the Society could wait no longer either, and moved to help in the effort. TNC was written, but replied they were helpless due to the exhorbitant prices involved in saving this pristine bit of coastal meadow. So Xerces appealed to Senator Mark Hatfield, who has been outstandingly progressive in conservation and other humanistic legislation. Senator Hatfield replied enthusiastically with support, saying he "has asked the Oregon Parks and Recreation Board for a complete report on the possibility of a habitat reserve being established" at the site in question. As we go to press, we have heard no more since this gratifying turn. If members and friends want to help in this particular battle between butterflies and bulldozers, they can write, expressing their support for a State Park Nature Reserve for the Zerene Fritillary at Tenmile Creek, near Cape Perpetua, on the Oregon Coast. Send letters to: Mr. Raymond Wilson, Land Acquisition, Parks and Recreation, Administration State Highway Bldg., Salem, Oregon, USA, 97301. We strongly urge you to do so!

....AND WORKS TO HELP THE KARNER BLUE IN NEW YORK
Meanwhile, across the country, Associate Director Jo Brewer received another plea for the Society to intervene in an issue meaning much for another butterfly's future. Jim Cane, Corresponding Secretary of The Regional Entomology Club of Albany, N.Y., wrote Jo with bad news about Lycaeides (Plebejus) melissa samuelesis. This small blue, named by famed novelist/lepidopterist Vladimir Nabokov, used to extend from British Columbia to the Catskills, according to Cane. "However," he writes,"this butterfly is now down to one final foothold, one last colony, located outside Albany, in the Pine Bush area of Karner. And this area is rapidly succumbing to the onslaught of the bulldozer and concrete." (Ed. Note: Bulldozers are really getting it in this issue!) Cane went on to describe the unique nature of the Pine Bush, from which the Karner Blue derives its local vernacular name. "At this moment,"he concludes,"The Nature Conservancy is doing all that it can to purchase parcels of land to be set aside in the Pine Bush. The cities have donated a handful of acres. But this will not be enough. We ask you to enter publicly into the preservation of this butterfly and its habitat."

Our action was three-pronged. Probing the Chief Counsellors revealed important biogeographic and ecologic data. CC. Bill Sieker noted that the butterfly had
(continued next page)

KARNER BLUE, CONTINUED

been taken recetly in Wisconsin, but that it was indeed rare and all efforts at protection were worthwhile. CC. F.Martin Brown cautioned that, even if sufficient habitat is set aside, burning and other management will be necessary to perpetuate the Pine Bush, and that this will be harder yet to insure. I wrote to Honorary Counsellor Nathaniel Reed, Assistant Secretary of the Interior for Fish and Wildlife and Parks, for aid; and to Governor Rockefeller, peitioning his support as prime guardian of the New York resource base. Reply came from a state environmental official that they would cooperate if possible, and were glad to know of the significant Karner Blue (gives them added ammunition). Jo/~~Brwere~~ Brewer and CC. Ivy LeMon are investigating the situation on the ground, and a powerful local publicity campaign is underway. The Society hopes to focus the concern of our friends on the matter: PLEASE WRITE Governor Rockefeller, Albany, asking for protection AND management for the Pine Bush on behalf of those who value the Karner Blue. If our pressure helps toward a successful resolution, the Karner Blue may not follow the importunate route of the Xerces Blue into extinction. Let it fly.

ON THE WING X ON THE WING X ON THE WING X ON THE WING X ON THE WING X ON THE WING

N E W S * B R I E F S

SOCIETY ACQUIRES FIRST RESERVE: Through the generosity of Harold and Anne Johnston, A fourteen-acre homestead of coniferous and deciduous forest, creek-bottom meadow and marsh has been vested in the Xerces Society as our first butterfly reserve. The farm is located on Big Soos Creek in the Green River drainage near Kent, Washington. A new state law enables nature reserves to operate free from property taxes, hence the owners' idea to donate the land. With Jon Rousch of TNC in Portland doing the legal work, the transfer should soon be completed. Existing structures on the site may eventually become a headquarters and interpretive center for the Society. A butterfly survey awaits warmer days, but the Director feels that the diversity of the site should make it ideal for managing most species of Puget Sound Basin butterflies, which have been retreating progressively from the Seattle Metropolitan area. The preliminary master plan calls for development of the full interpretive and educational potential of the Big Soos Reserve.

LEP. SOC PASSES RESOLUTION: The Pacific Slope meeting drafted a foreward-thinking conservation staement, which was sent to President Lloyd Martin and forwarded to the Lepidopterists' Society Conservation Committee. The resolution reads: "Whereas the Lepidopterists' Society has an interest in the recognition and preservation of existing natural ecological associations to which native, non-economically detrimental Lepidoptera are adapted; And Whereas the Lepidopterists' Society recognizes a general decrease in the extent of undisturbed ecological associations: Be it resolved that the Pacific Slope Section of the Lepidopterists' Society recommends that the Society initiate action toward: 1) Incorporating into governmental laws aimed at protection of "rare and/or endangered species" species, subspecies, or specified populations of native Lepidoptera; 2) Gathering, maintaining and making available for dissemination information relating to endangered habitats and/or species." Ray Stanford shall pursue these ends in the West on behalf of the Society, and an active liaison is expected.

PROJECT PONCEANUS AND OPERATION ATALA: America's two most endangered species of butterflies are the Ponceanus Swallowtail and the Atala Hairstreak, both of the Everglades area. Gross environmental changes, coupled with hurricanes, have diminished populations dangerously, and Atala may in fact be on the brink of extinction. Project Ponceanus and Operation Atala are being undertaken by Charles Covell and George Rawson to determine the actual status of the butterflies and means of further protection. Detailed reports on both programs will be printed in the next issue of Atala.

H O W T O H E L P

The many inquiries that have been received share a common tone:"How can I help conserve butterflies?" is the refrain I read again and again. A coalition of concerned people is worth no more than its collective sentiment unless avenues of expression can be found for that concern. The Xerces Society exists partly to discover the problems; partly to combat them itself, as a citizen/scientific body; and partly, perhaps mostly, to help individuals to focus their own energies in an effective manner. So on this page we have summarized some of the ways in which YOU can help.

1) Familiarize yourself with the butterflies of your area so that you know their names and their needs and can recognize both. We are preparing a bibliography of regional, state and local sources to help with this.

2) Be on the lookout for butterfly conservation problems in your area. If you are knowledgeable, become a state or local focal person(next page). Otherwise send information to the directors or to your area's focal persons.

3) Set up or join a local group of the Society (Chrysalis) to work locally.

4) Locate and contact other individuals interested in our goals, and introduce them to butterflies and the Xerces Society.

5) Initiate, promote or aid in the compilation of faunal lists and environmental surveys in your area, in order to locate any important populations of butterflies which may be threatened and should be safeguarded. A population is of interest if it is of national, regional or local significance; significance depends on relative rarity or value based on interest or education or esthetic value to the community.

6) Direct or help in the process of reserve acquisition or establishment, through purchase, donation, agreement or scenic lease; and in the wardening i interpretation and necessary management of reserves.

7) Raise funds for expenditure by local groups or for national priorities.

8) Engage in the rehabilitation of butterfly habitat on waste ground, by planting larval food plants and adult nectar sources such as Buddleia.

9) Work for beneficial land use decisions by agencies, lobby for important environmental legislation, and represent the Xerces Society at conservation ~~he~~ hearings (contact the directors or a Chief Counsellor first).

10) Promote research on local,regional and continental butterfly populations; lead or encourage school studies and projects with Lepidoptera, stressing conservation; generally raise community interest and awareness of butterflies.

.....abd there is one more: SEND MONEY, if you can afford it!! Surely there are many more ways you can jelp, and we will be anxious to receive feedback and suggestions. This newsletter will carry stories on successful projects, and the directors will gladly answer queries.

CRYSALISES

Local groups of the Xerces Society, called Crysalises, are very loosely structured. All that's needed are two or more members and compliance with Society goals and principles. If you are interested in starting a Crysalis, or wondering if there is one in your area, write the Director for full information. The first Crysalises or only just now beginning to form.

STATE AND LOCAL FOCAL PEOPLE:

The kinds of issues which have arisen already have shown graphically that a system of regional node people would be a great boon to the movement. We have set about trying to construct a grid of sych persons who will serve two vital functions: First, the STATE AND LOCAL FOCAL PEOPLE WILL KEEP A CLOSE EYE on butterfly situations in their own territories. Then when a problem becomes apparent to them, they will gather information and forward a situation report to the Director or Associate Director. A plan can then be worked out for how to approach the issue, dividing tasksas necessary between the national body and the local members. Second, the STATE AND LOCAL FOCAL PEOPLE WILL DIRECT, inasmuch as their own time permits, the on-the-spot action of a issue, in coordination with the national body. This system is already underway in several cases, such as with the incredibly local Apodemia mormo langei, a Bay Area Metalmark of immense rarity: Jerry Powell is serving as Focal Person for the area and is coordinating the effort on that issue, as well as amassing and analyzing data on California coastal populations in general. Mike Toliver is New Mexico Focal Person; he watches out for the newly discovered Sandia macfarlandi, a very special hairstreak, for one thing. The idea, then, is for the State and Local Focal People to watch for and substantially handle the brush fires which occur, with help from the Directors and the Chief Counsellors.

This issue of Atala has been sent to numerous people who have been selected from the Lepidopterists' Society membership list as likely or potential focal people. Anyone else, of course, will be considered equally. There is no present limit to the number of people who can seve in this capacity: If we get overlapping for a particular region, all the better coverage should be provided. One individual will be appointed as State Focal Person for each state (or Province) however, to aid in coordination. Focal Persons are functionaries of the national organization, who may or may not be affiliated with local groups. STATE AND LOCAL FOCAL PEOPLE ARE NEEDED NOW!!!!

IS THIS YOUR NICHE?

The persons who eill serve as State and Local Focal People should be EITHER 1)competent lepidopterists with a conservation interest;or

2)experienced environmentalists with an interest in lepidoptera; or

3)concerned people willing to learn fast about both conservation and lepidoptera. Obviously a ready acquaintance with the butterflies of your area will help you to carry out this task, and will be essential for any applied efforts. If you think that being a State or Local Focal Person sounds like the right conservation involvement for you, then write quick with your vita and a statement of the area you would like to cover. IF YOU ARE REALLY INTERESTED, DON'T BE AFRAID TO WRITE BECAUSE YOU THINK YOU AREN'T QUALIFIED! PEOPLE GET QUALIFIED BY DOING. The Xerces Society will ask no more time or energy than a member has to give. This job will take some time--but it may also provide a personal kind of gratification seldom received from fringe involvement with a large organization. The State and Local Focal People will be performing vital works which are absolutely unduplicated, in a society and time when most of us feel increasingly superfluous.

XERCES PERSONS -- THE NATIONAL INFRASTRUCTURE

DIRECTOR: Robert Michael Pyle. Vitally interested in butterfly conservation for over a decade, Pyle has written several articles on the subject. He received his B.S. in Nature Perception and Protection from the University of Washington in 1969, and his M.S.in Nature Interpretation in 1973. Pyle has worked with campus environmental groups, the Sierra Club, the Audubon Society and others on a volunteer basis, and professionally as an interpretive specialist for the National Park and Forest Services and state and local resource agencies.As Fulbright-Hays Fellow to to Great Britain in 1971-72, he studied butterfly conservation with the Nature Conservancy. A ten-year member of the Lepidopterists; Society, Pyle will begin doctoral studies in butterfly conservation at ~~Yael~~ Yale this year. His book Watching Washington Butterflies will be published in May, 1973.

ASSOCIATE DIRECTOR: Ms. Jo Brewer. A professional writer, lecturer and wildlife photographer specializing in butterflies, Ms. Brewer has written two books and many articles on butterflies, their metamorphosis, habits, and place in the chain of life. Among her works are Wings in the Meadow a popular book about the Monarch butterfly, and the recent "How to Kill a Butterfly in Audubon magazine. She has lectured to the Royal Entomological Society in London and at the Institute of Zoology in Leningrad. Ms. Brewer is an active research worker with lepidoptera, and a member of the editorial board of The Lepidopterists' News.

THE CHIEF COUNSELLORS:

F. Martin Brown, well known and highly prolific lepidopterist; author of Colorado Butterflies and many more works on the biology, taxonomy, history and distribution of New World butterflies. Also an active Colorado conserver.

Charles V. Covell, Biology Professor at the University of Louiseville, editor of The Lepidopterists' News and dynamic director of Project Ponceanus.

John C. Downey, Professor of Biology at the University of Northern Iowa and a leading authority on lycaenid butterflies.

Scott Ellis is working on Speyeria nokomis conservation and other aspects of westerm butterfly research, esp. Sulphurs, after studying at Cornell.

Ivy LeMon carries on the butterfly programs of the Massachussetts Audubon Society, takes part in Monarch research, and worked with Beebe in the Tropics.

David McCorkle, Oregon college teacher, has tackled several Northwest butterfly conservation issues. He is a highly active and sensitive researcher.

George Rawson has been a Naturalist in Everglades National Park, is now an Associate Collaborator at the Smithsonian in Lepidoptera. Rawson heads Operation Atala and is also very involved with Project Ponceanus.

Charles L. Remington, Professor of Environmental Biology at Yael, is an Honorary Life Member of the Lepidopterists' Society; maintains a special collection and evolutionary research interest in endangered and extinct leps.

William E. Sieker, international sphinx moth expert, is an attorney who has worked with Audubon and is helping with legal matters for the Xerces Society.

John Sorenson is a Berkely lepidoptera researcher who has published his ideas on butterfly conservation and extincton.

THE HONORARY COUNSELLORS: We are honored to have the support and advice of:

Dorothy Bradley, Montana State Legislator and active environmentalist.

Margaret Murie, naturalist, author of Wapiti Wilderness, distinguished wildernis

Nathaniel Reed, Assistant Secretary of the Interior for Fish and Wildlife and P

Edwin Way Teale, Pulitzer Prize winning author of The American Seasons and renowned entomologist, philiosopher and photographer.

Roger Tory Peterson, Audubon Medalist, celebrated, author, naturalist and painter/photographer. Initiated the Field Marks System and has a keen interest in butterflies and their conservation.

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S E N D M O N E Y....

A NOTE FROM GROTE (the first one on his block to save a butterfly)

The first person in America to raise his voice on the issue of butterfly conservation was probably A.R. Grote. In his forward to Grote's An Illustrated Essay on the Noctuidae of North America, with "A Colony of Butterflies", 1882, reprinted by Eric Classey, London, 1971, Ronald S. Wilkinson wrote: "Grote's call for protection of the White Mountain Butterfly was a pioneer American effort in the conservation of Lepidoptera. His request for legal protection was not heeded, but at least in this case, the results have been favorable. Due to its isolation, habits, and the good sense of those collectors who do visit Mount Washington, the colony still thrives...Unless conditions change, Oeneis melissa semidea appears appears to be safe." Grote's essay was about the effects of glaciation on the distribution of butterflies, particularly the isolated colony of O. m. semidea on Mt. Washington in the White Mountains of New Hampshire. His note of caution comes at the end of the essay: "Yet they maintain themselves (in spite of the drastic conditions under which they live)) They are fighting it out on that line. They are entrapped, and must die out by natural causes, unless certain entomologists sooner extirpate them by pinning them up in collections of insects.

"What time, on'Bigelow's Lawn,' I see the ill-advised collector, net in hand, swooping down on this devoted colony, of ancient lineage and more than Puritan affiliation, I wonder if, before it is too late, there will not be a law passed to protect the butterflies from the cupidity of their pursuers.

"This is the story of a New-England colony of butterflies. I commend this colony to the protection of all good citizens of the State of New Hampshire."

Perhaps Mr. Grote overestimated the effectiveness of avaricious collectors as potential predators, and neglected the more important threat of habitat deterioration. But his heart was in the right place, and he deserves homage as one of our true and earliest forebears.

BE THE FIRST ON YOUR BLOCK TO SAVE A BUTTERFLY_____

SEND IN A DONATION TODAY!!

Seriously--The Xerces Society operates entirely on contributions. To date, these have been insufficient to allow us to pursue aggressively the many programs we have outlined and begun. Literature needs printing and distributing, research needs funding, reserves need purchasing or leasing and managing. There is no apparent limitation to the work we can do, if we have sufficient energy resources and nomey. Certainly there is no shortage of issues!! Many problems arise yearly. New brush fires erupt with every ill-advised development, and we become aware of more endangered major populations every year. If they are lost it might not be because we didn't know what to do about them -- but because we couldn't afford to do it. Your donations have been greatly appreciated, but more are needed. EVERY DOLLAR WE RECEIVE WILL BE USED DIRECTLY FOR BUTTERFLY CONSERVATION. Thank you.

....S A V E B U T T E R F L I E S

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ON THE WING: CONTINUED

XERCES WORKS TO HELP PROTECT THE SANDIA HAIRSTREAK: Our most recently discovered butterfly is Sandia macfarlandi, the Sandia Hairstreak, not surprisingly a resident of the Sandia Mountains of New Mexico. When the Director heard that a new land use plan was underway by the US Forest Service for the Sandias, he contacted Focal Person Mike Toliver and Hairstreak Authority Harry Clench for information. Thus girded, we were able to prepare testimony for the Forest Service hearing on the future of the Sandias. The Forest Supervisor of the Cibola National Forest, W.L. LLoyd, indicated the ageny's interest in learning of this important and local butterfly. We were assured that the management plan would take into consideration our proposals for protecting the foodplant and habitat of the butterfly.

"I dreamed I saw the bombers, flying shotgun in the skies

Turning into butterflies, over our nation."

--Joni Mitchell

FROM: THE XERCES SOCIETY
c/o R.M. Pyle
Forest Resources, UW, Seattle
Washington, USA 98195

TO:

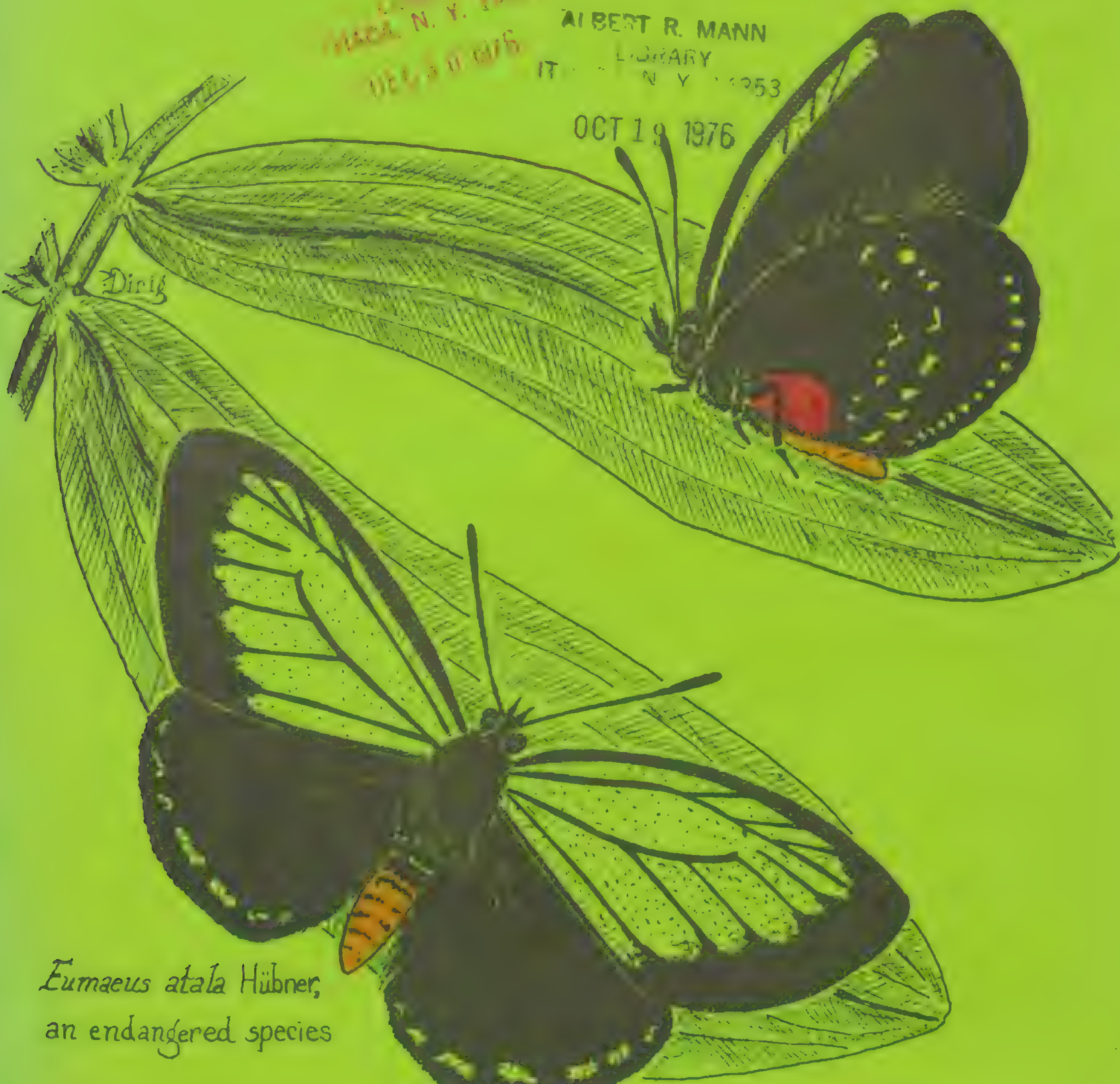
COMING IN FUTURE ISSUES
Forthcoming Atalas will carry articles including: Dams and Butterflies on the Columbia River--The Xerces Blue Story--Old World Inspiration(butterfly conservation in Great Britain)--Bibliography of butterfly conservation--Lists and news of State and Local Focal People and the first Crysalises--Current Issues--Progress Report on the First World Conference on the Conservation of Lepidoptera--Does collecting harm butterfly populations?--And More! Please send in news, comments or whatever to the Director.

"For the perpetuation of rich, natural populations of butterflies"--

THE XERCES SOCIETY

ATALA

Vol. I, No. 2 9 December, 1973



Eumaeus atala Hübner,
an endangered species

Communication of the Xerces Society

COVER BUTTERFLY

Eumaeus atala Poey was described in 1832 from Cuba. In the U.S. it occurs only in the south of Florida. Its sole larval food plant is *Zamia pumila*., or Coontie.

This lycaenid is a weak flier, and may not travel far from its larval site. Until about 1933 it was common--sometimes abundant--around Miami and the Everglades National Park; but it may now be among the rarest North American butterflies.

Holland in his BUTTERFLY BOOK (1930) reported that the butterfly swarmed in the region of the everglades; but between 1933 and 1940, records of sightings were scarce. After 1940 no specimens were collected for many years, and Klots in A FIELD GUIDE TO THE BUTTERFLIES (1951) referred to *atala* as very rare--possibly extinct in the United States.

Then in 1959 a few specimens were hand-caught in a park in Broward Co. by the father of Jack Dempwolf, a butterfly collector. This discovery led the following year, to the first known U.S. effort to conserve a butterfly population, for in 1960 Dr. George W. Rawson, a Florida resident, was asked to introduce the species into the government protected Everglades National Park. Dr. Rawson captured a few females, confined them with the food plant *Zamia*, and obtained 31 eggs which he reared to chrysalids. These were transported to the Everglades National Park, and the resulting butterflies were released there in an area near where the species had once been common.

Shortly thereafter, in September 1960, Hurricane Donna struck, and there was no indication that the colony survived. In June 1961, 44 more adult butterflies were released in the same area of the park, but apparently these, too, failed to become established. *E. atala* was last reported from the Broward Co. site in March 1963. Repeated checks have all yielded negative results, and I believe that the colony is now extinct.

Why did this last known colony of *atala* vanish? The clearing of *Zamia* habitats, fro and hurricanes, pesticides sprayed or dusted from the air on vegitable crops and fogging for mosquito control, predators, parasites and competition from other *Zamia* feeders, and over-collecting may all have played a part. Some think that *atala* may already be extinct in the U.S.. Others believe, as I do, that there may be other colonies as yet undiscovered, somewhere in southern Florida. But unless such can be found, this lovely butterfly may well be the next in the United States to be declared extinct.

Charles V. Covell Jr.

Ref. Rawson George W. RECENT REDISCOVERY OF *EUMAEUS ATALA* (Lycaenidae) IN SOUTHERN FLORIDA. J. Lepid. Soc. vol.15, no.4 P. 237.

Charles V. Covell Jr. is a member of the Biology Dept. of the University of Louisville, Louisville Ky. and a Chief Counsellor of the Xerces Society. The history of *Eumaeus atala* was taken from a paper NOTES ON THE STATUS OF TWO ENDANGERED BUTTERFLY SPECIES IN SOUTHERN FLORIDA which he presented to the Entomological Society of America in November 1973.

COVER ARTIST, Robert Dirig, is a graduate student at Cornell University, Dept. of Plant Pathology. He has done drawings for TIEG, and recently published an article THE ENDANGERED KARNER BLUE illustrated with his own drawings and photographs, in THE CONSERVATIONIST. The pinned specimen at top right of the cover is symbolic of the fact that in the near future we may only be able to see *Eumaeus atal* as a museum specimen.

"I dreamed I saw the bombers flying shotgun in the skies
Turning into butterflies over our nation."

--Joni Mitchell
(Woodstock)

COME TO THE ANNUAL MEETING!

The Xerces Society was two years old on December 9, 1973, but a membership meeting has yet to be held. The first Annual Meeting of the Society will take place at Yale in April, so we earnestly hope many of our Northeastern members will attend. See details on page 7 of this issue....and plan to come!

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want to help save butterflies -- but don't know how?

HELP IS ON THE WAY

The Directors answer a great deal of mail about the Xerces Society, and our role in protecting endangered populations of butterflies. Many letters refer to issues and conservation problems, others relate members' experiences and activities. But the greatest portion of our mail consists of queries, and the most abundant question is: "What can I do to help save butterflies?" Since it has been physically impossible to maintain frequent follow-up communication and feed-back with every interested person, a certain amount of frustration has accrued to people anxious to help, but uncertain how to go about it. One of the society's chief functions is to catalyze such people, and to focus their energy as a valuable resource. We think we may have found a way, and that it may not be too distant.

To direct your good intentions, we are going to be preparing and sending you a series of individual and community self-help sheets for lepidoptera conservation. The aids will appear from time to time, as they can be written and checked out. To save on postage, they will be sent along with either *Atala* (twice yearly) or *Wings*, the newsletter (quarterly). These help sheets will be identified as such, and will probably be punched so they may be assembled into a special loose-leaf folder to serve collectively as a conservation handbook.

The kinds of things you will be told about in the series of help sheets will not usually be the same sorts of projects in which the Society is engaged on a national or regional basis. Instead, they will consist of projects, measures, studies, works or programs which can be carried out by concerned individuals or by local groups of individuals such as clubs, classes, Xerces units or scout troops. We will concentrate on items which will not require a great deal of prior expertise, but which will be teaching and learning experiences in themselves. Here are some of the topics to be covered in future help sheets:

How to acquire and manage a small butterfly reserve--Protection methods for threatened sites--Gardening for butterflies--Creating a butterfly awareness center--Community politics of preservation--Working for effective legislation--Conducting simple population studies--Butterfly walks and counts--Making faunal surveys--Investigating life histories--Butterflies in nature interpretation and environmental education. Meanwhile, look for ideas in this issue!

POLICIES AND PUBLICATIONS

Xerces Conducts Policy Studies: Collecting and Introductions

In the face of increasing concern among members and prospective members, sometimes involving strikingly different opinions, the Xerces Society is seeking to define policies on two crucial issues. The first of these is collecting of Lepidoptera; the second, introducing populations to new locales. Both involve philosophy, ethics, individual and collective behavior of lepidopterists and the welfare of populations involved. Equally, both pose complex scientific questions, so that hasty judgements cannot be accepted for policy.

In the first instance, we are asking "Is overcollecting possible and should collecting activities be regulated or moderated?" We are also trying to reconcile the views of lay conservationists, some of whom feel all collecting should be discouraged, and lepidopterists, most of whom absolutely rely on collecting for their research and/or recreation. Our greatest concern is for populations which might be impaired by intensive collecting: HOWEVER, AT THIS POINT WE FEEL THESE ARE PROBABLY FEW, consisting of colonies already weakened by other forms of environmental stress. In the long run, it may be more important to head off a major schism between collectors and anti-collectors, which could rob the Society of valuable participants. Therefore, we are involved in an intensive study to determine both the scientific and philosophic factors involved. When we feel sufficient knowledge has been brought together, and our findings have been widely circulated, we will announce a policy for the Society, subject to approval by majority vote of the Chief Counsellors.

The same pattern of research will be followed in the formulation of a Society policy on introductions. Briefly, the problem is this: When butterflies (or any organisms) are introduced to a locale where they are not indigenous (native), they may cause severe ecological problems. These problems include becoming an economic pest due to lack of natural population controls and presence of a new food source, supplanting or interfering with native populations, and, most insidious, causing extinction or weakening of native populations of the same species through genetic dilution. Introductions also cause immense headaches for biogeographers, who try to catalog the natural occurrence and range of organisms. The importance of this question cannot be overstated: One need only look at the spectacular spread of the Cabbage White to understand the problem. In developing a draft policy, the Society is following the important British document, Policy on Introductions to Nature Reserves (Society for the Promotion of Nature Reserves, Conservation Liaison Committee, Tech. Pub. 2). For the present, we subscribe to the basic tenets thereof: No introductions to areas outside the normal range of a species or subspecies and no in-range introductions unless from neighboring populations.

WE NEED INFORMATION FOR BOTH OF THESE STUDIES!! PLEASE send any opinions, references, experiences and especially hard data relating to either policy to the Director. The viability of these policies depends on being informed.

PUBLICATION SCHEDULE ANNOUNCED Atala, the formal communication of the Xerces Society, will appear twice yearly in spring-summer and fall-winter issues. Wings, an informal newsletter, will be published quarterly and mailed between the mailings of Atala.

CURRENT ISSUES IN BUTTERFLY CONSERVATION

Xerces members publish findings: Two ongoing issues in which Xerces has been deeply involved received publicity recently when their respective authorities wrote about the results of their research. Chief Counsellor Dr. Charles Covell reported on his own Project Ponceanus in the Journal of the Lepidopterists' Society (number 3, 1973). Dr. Covell, working from results obtained during his 1973 expedition to the southern Florida home of the extremely rare Schaus' Swallowtail (Papilio aristodemus ponceanus), submits cautious good news. Apparently, the butterfly still occurs in reasonably good numbers in Key Biscayne National Monument, where it is protected by the National Park Service, and in a very few other sites. This is not, cautions Covell, any reason to abandon vigilance over this spectacular and local subspecies. The total population is still considered small, and the breeding sites are relatively disjunct--making them especially vulnerable to hurricanes. Once considered nearly extinct, ponceanus survives, if tenuously. Through continued efforts of Project Ponceanus, we should be able to learn how to give it the best possible chance.

Meanwhile, Area Activist Robert Dirig pursued the complex issue of the Karner Blue (Plebejus melissa samuelis) in the Albany, N.Y. Pine Bush. Xerces has been trenchantly involved in the struggle to protect the Pine Bush as one of the few remaining habitats for this highly local blue and its lupine foodplant. In the autumn issue of the New York Conservationist magazine, Mr. Dirig summarized the present state of the problem. In short, concerted efforts proceed to try to protect a reasonable piece of the area; but the outcome is not yet predictable. Members should continue to write their support of Pine Bush conservation to Albany and state officials. (Mr. Dirig, who illustrated his article superbly, also provided the cover illustration for this issue of Atala.)

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Silverspot Salvation Summaries: Among the most exciting projects currently enjoined by the Xerces Society are efforts to conserve two spectacular silverspot butterflies: The Nokomis Fritillary in Colorado and the Oregon Silverspot in -- where else -- Oregon.

The Nokomis Fritillary, a great, firey beast, flies sparsely across the southern Great Basin. Colorado hosts a very few colonies of the type subspecies, Speyeria nokomis nokomis. The best of these resides in an isolated seep in a desert canyon in Mesa County. Chief Counsellor Scott Ellis, bred of that country, keeps an eagle-eye on the bog and works constantly toward its certain protection. In a detailed letter to the director recently, Scott recounted his campaign. Approaches to the rancher/landowner, the Bureau of Land Management, local and regional biologists and geologists and The Nature Conservancy have yielded varying degrees of promise. TNC is interested and Mr Ellis is pursuing this route tenaciously. Ellis plans to publish a paper on the colony, integrating paleoclimatic research with historic information and scientific recommendations for conservation.

On the coast, another beautiful fritillary is being saved, although it doesn't know or care. Chief Counsellor Dave McCorkle spearheads the drive to protect S. zerene hippolyta, denizen of coastal meadows (= prime development land). Xerces reached concerned Senator Mark Hatfield on this one, and he helped us to catalyze what may become

(SILVERSPOTS, Continued) our most successful effort to date: A conservation consortium involving Oregon State Parks, The Nature Conservancy and the United States Forest Service. The latter came to us, when USFS Wildlife Biologist Gene D. Silovsky wrote to ask our help in locating and managing Oregon Silverspot habitat on the Siuslaw National Forest. Exemplary agency cooperation like that certainly makes the effort seem worthwhile! We hope to have a complete report on the issue from Mr. McCorkle for the next Atala.

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News from the RESERVES

Big Soos Donation Imminent; but Decimation Danger Looms

In the previous number of Atala, the donation of a 14-acre western Washington state farm to the Society was reported. Since then, legal procedures have been negotiated by Ken Margolis, Northwest Director of The Nature Conservancy. Harold and Anne Johnston, who have fostered over 100 homeless children and numerous animals on the land, should be able to complete their generous, protective act by spring. Recent state legislation will exempt the Big Soos, as a nature reserve, from property taxation. However, one large problem remains. Oppressive back taxes may force the sale of one acre of the reserve before the donation can be consummated. The lamented, projected sale parcel consists of open Douglas-fir forest. While not in the heart of the reserve, this tract does provide Neophasia menapia habitat as well as important buffer from development. It is also a very pretty acre which would be sad to lose from the farm, in any case. Will we be forced to establish this unfortunate precedent by carving up our first reserve before we even acquire it? If any members can suggest alternatives , PLEASE do so immediately. The sum involved is $3000, an amount much larger than our total treasury contains.

Meanwhile, plans for the Big Soos Butterfly Reserve continue to evolve. The Society Director resided at Big Soos for the month of July, gathering data and impressions, formulating an embryonic master plan for management and interpretation, and soaking in the swimming hole in Big Soos Creek after excursions into nettle patches. Eighteen species of butterflies were recorded on the reserve during 1973, including the relatively rare (near Seattle) Mardon Skipper. Large Wood Nymphs were most abundant, and several nymphalids were observed ovipositing. The donkeys and butterflies seemed to coexist. In fact, the former may prove necessary in management plans, to help maintain a meadow regime in this forest-clotted landscape. One idea we hope to bring to fruition is creation of a Greater Seattle Butterfl Awareness Center (for interpretation and education)in the fine barn.

The Drum Manor Butterfly Garden, Ulster. Coming in good time to provide ideas and methods for Big Soos is news of an elaborate butterfly interpretive facility in Northern Ireland. In a fascinating article in the Intern. J. of Environmental Studies, Vol. 4, 1973, Henry George Heal describes the creation of a butterfly garden in a government Forest Park near Cookstown, Co. Tyrone. Developed in the walled garden of an 18th century Irish gentleman's estate, the garden aims to conserve butterflies, edify visitors, and educate the public to garden in a less tidy way to benefit butterfly populations. Heal writes: "The Butterfly Garden is not a zoo; the butterflies in it come and go at will. They are the native species of the district... It is the designers' aim to make the Garden so attractive to the local butterflies that they will congregate...and establish breeding coloni

RESERVES NEWS (Continued: Drum Manor) The Garden achieved early success at these aims, judging from the tables included: More than half of the North Irish butterfly species present, several more expected, bringing the total to 20+ species; about 100butterflies of half a dozen species present within the 64X64metre garden on a cool September day when butterflies were generally hard to find. The Xerces Director plans to visit Drum Manor next June. Helpful parallels with Big Soos should be apparent, especially with the Northern Ireland--Washington State climatic exingencies so similar. Hopefully we won't have to deal with some of their other endemic difficulties! The Northern Irish Forestry Commission are to be heartily commended for this pioneering effort and its striking success.

Cooperating Reserves Request Xerces Aid. As our Society's goals and expertise becomes more widely known, we receive increasing numbers of requests to help advise nature reserve managers on matters of butterfly habitat management. This can be bewildering, since individual species requirements are often very exacting. The Society has taken on several such requests however, and we look forward to the joint ventures. One such cooperating area is the Regina Laudis Monastery in Bethlehem, Connecticut. Mother Maria Nugent works with the lepidoptera on the 300 acre natural site, Sister Hildegard with the flora. Local Xerces members hope to aid in the planning and work for butterfly conservation management. Another special privilege is the opportunity to work with managers of the superb Schlitz Audubon Center preserve, a former draft-horse farm turned nature reserve on Lake Michigan near Milwaukee. Sensitive and energetic naturalist Don L. Danielson, who knows the butterflies, approached us on behalf of the National Audubon Society. The ecological diversity of this 200-acre system offers really substantial promise for native butterfly conservation.

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NEW BOOK NOTICES

These three new books should be of special interest to Xerces members.

The Butterflies of Southern California, by Thomas C. Emmel and John F. Emmel. Ward Ritchie Press, 1973. 100 pp. text, 10 color plates illustrating over 160 species and subspecies, numerous halftones of the Comstock and Dammers life history paintings. Co-author Tom Emmel, an Area Activist for the Xerces Society, writes that this new book includes much information on conservation of butterfly populations in the region. (This is very heartening, since extinctions have already occurred due to the SC syndrome.) Price about $10.00 paperbound, from Entomological Reprint Specialists, Box 77224, Dockweiler St., Los Angeles, CA. 90007.

Butterflies of Illinois (Annotated Checklist), by Roderick R. Irwin and John C. Downey. 60 pp., one halftone, 98 maps. An excellent, carefully researched document available FREE from Illinois Natural History Survey, Urbana, Illinois, 61801. Author Downey is a Xerces Society Chief Counsellor. State of Illinois, 1973.

Watching Washington Butterflies, by Robert Michael Pyle. 125 pp., 64 color photographs from life. The Xerces Director's book emphasizes conservation, perception. $3.95 from Seattle Audubon Society, Joshua Green Bldg., Seattle, WA.98101. Available May 1, 1974.

ROADSIDE COLLECTING

Christian A. Adams
28 Chestnut Street, Salem, New Jersey

For 5 years a different kind of collecting program, a conservation oriented method of collecting, has been taking place in New Jersey. Specimens killed on busy highways by passing vehicles have been amassed into a collection.

A bicycle is mounted on the rear of a car allowing mounting and dismounting of the bike in seconds. The car is driven to suitable habitats and the bike dismounted. A collecting box, cushioned inside and out is placed in the front basket of the bike. A forceps is secured to the top of the box for easy access during travel and location of specimens. In short, the collecting box replaces the net of field collectors.

Roadside collecting between 10:30 or 11:00 and 1:00, on warm, sunny days gives the best results, although collecting can be done until dark. Maximum yields may be obtained if one rides roadsides containing suitable habitats on one or both sides of the road where a reasonable amount of traffic travels about 40 mph to about 55 mph. (Walking in good locales at or around noon gives fair results but usually a lesser number of species and specimens is found since distance traveled can never compare with that of a bike.)

A few of the advantages of this method are; 1) the quality (condition) of specimens is often surprisingly good; 2) the yield (number of specimens and species) compares favorably with good field habitats; and 3) colonies of the more desirable species suffer little chance of over-collecting even if the roadside is collected day after day for weeks.

Some of the more important records achieved during the course of the project follow.

Records are for single days unless otherwise noted.

Total specimens	520 (est.)
Total specimens of single species	440
Total species	31
Total species (5 yrs. in N. J.)	100

EDITOR'S NOTE:

Members will appreciate this fascinating, novel article by Xerces Area Activist Chris Adams. There is another side to road-kill, also: To what extent is this a mortality factor for lepidoptera? Some lepidopterists think road-kill very important in some areas. Hard data is still very scarce, and so studies of this kind take on a double importance, providing base-lines for comparison. Members may wish to repeat this activity in their areas; by all means, report your data so that it can be employed for study!

"MEETINGS" MEETINGS

The Annual Meeting

Xerces Society members and friends will gather in numbers for the first time on April 20-21, 1974, at Osborne Memorial Laboratory, Yale University, New Haven, Connecticut. The meeting will convene at the generous invitation of Dr. Charles L. Remington, Associate Professor of Biology, Honorary Life Member of The Lepidopterists' Society and Chief Counsellor of the Xerces Society. Along with Professor Remington, the program will hopefully include veteran New England lepidopterist Sidney Hessell. Honored Guest and Major Speaker will be John Heath, Zoologist for the British government's Biological Records Centre, Institute of Terrestrial Ecology; Founder and Secretary of the European Invertebrate Survey; Editor of the Atlas of the British Lepidoptera; and pioneer in the sophisticated British butterfly conservation movement. The meeting will include papers, discussion and workshops for action, as well as social pleasures, entertainment and hopefully a field trip to see the scarce Pieris virginiensis and West Rock Park, richest New England butterfly habitat. We sincerely hope that many of our members will plan to attend and take part. Car-pools will be organized, and New Haven lies on Amtrak and major bus lines, and is serviced by Pilgrim and Allegheny Airlines. Housing assistance will be provided. Write the Director for details.

The Directors' Meeting

November 3-5, 1973 saw a long-overdue colloquium take place between Xerces Society Director Bob Pyle andAssociate Director Jo Brewer at the latter's pleasant Charles River home outside Boston. Agenda items accumulating for nearly two years underwent three days of intense thrashing and combing as the directors took advantage of first-person communication in an effort to organize and streamline the Society's concerns. Matters which had been deferred, defused and confused by months of trans-Atlantic and trans-continental correspondence now had a chance to blossom or bust directly. In addition to dozens of national and regional issues, we discussed international liaison, future meetings, policies and publications. But by far the majority of our time centered on the crucial problems of people and money. We went through the entire membership list and revised it with annotations, examined heaps of each other's letters, and explored the roles of members, Area Activists (formerly focal people), Chief and Honorary Counsellors and Directors. We delineated our feeble financial condition, agreed we NEED a qualified treasurer (where are you??) and debated use of funds and whether or not to seek tax-exempt status. Finally, the interim by-laws underwent tortuous re-working to establish a democratic mandate. After further refinement, all this will be presented to the membership. Our refreshment consisted in delightful visits from Chief Counsellor Ivy LeMon and Harvard lepidopterists John Burns and Bob Silberglied. Adjournment showed a lot done and much more waiting to be done. Our outstanding conclusion: The membership represents a tremendously rich and varied talent-base and resource;now, how best to invest it?

The First World Conference on the Conservation of Lepidoptera

MEETINGS (Continued: First World Conference) The international symposium has been postponed for one year, until 1977, since the European Invertebrate Survey will be meeting in Lund, Sweden during the summer of 1976. Still planned for the Pacific Northwest, the FWC continues to evolve with many details already set. Numerous agencies and organizations will be taking part, and we hope to register fifty conferees from outside the USA. Butterfly conservationists interested in attending should write the director. We hope to offer full stipends to foreign participants who otherwise could not attend. The Citizens' Stamp Advisory Committee has been petitioned to consider printing of America's first butterfly commemorative stamps to coincide with the First World Conference. Members wishing to support this request may wish to write the Committee at Box 764, Washington D.C., 20004.

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Various publications have generously afforded space to notify their readers of the Xerces Society. These include TIEG Newsletter, NEWS of the Lepidopterists' Society, Catalyst for Environmental Quality, and the publications of the Entomological Societies of Canada and Michigan and Oregon. Thanks to these, we have had many responses and queries. The following excerpts of responses to the previous number of Atala are representative of the many reactions we have received.

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TO DANAUS PLEXIPPUS

Once we tasted nectar
And bathed in blue dew;
Once we soaked up sunshine
And springtime was new.

Now the earth is dying,
The trees choke their leaves;
Now the sun is fading,
The wind comes in heaves.

So we start our journey,
The end now begun;
So we travel southward,
Tangential to the sun.

-- Victoria Hoff, Erie, Pennsylvania. (Victoria is an Area Activist studying Lake Erie shore niches)

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"In his letter, the director sells short the 'eco-roles' of butterflies. Butterflies as herbivores exert a powerful pressure as agents of natural selection on their food plants, many of which, in turn, are immediately important to man's interests, and all of which may be important to a healthy biosphere. Butterflies may also be excellent indicators of local levels of pollution. In the lower Rio Grande Valley of Texas one can hardly find a Colias or a Pieris flying around due to the spraying of the citrus; one can imagine what the population levels of insects which act as natural controls on citrus and other crop pests must be like. I have observed the same phenomenon in the cotton-growing regions of Mississippi, and when in the Netherlands I was told that 60% of the butterfly species that used to be common there have essentially disappeared in the last two decades. I think the Xerces cause is a good one; however, I would like to see it take the attitude that butterflies are sensitive indicators of the shape of ecosystems, rather than the clubby, aesthetic arguments that are usually advanced by conservation organizations."

-- Dr. Peter F. Brussard, Ecology and Systematics, Cornell University

ON THE WING (Continued: Readers' Responses)

"On reading your letter to the Society my thoughts went back to my boyhood in New York City -- when the world was young. At that time in the boroughs outside of Manhattan there were still great open fields and wild areas of secondary growth. A short distance from my home was an entomologists' paradise -- enormous fields of uncultivated wild flowers and weeds that grew up above our heads and a jungle of tangled shrubs and trees covering a varied terrain, including swamps. At thirteen we became great collectors of insects -- I only superficially, but my friend went on for a doctorate in entomology. There were unbelievable numbers of butterflies and also moths....I mention this now because it is all gone -- not only from the city but from the surrounding suburbs also. In the summer we rarely see any butterflies, except passers-by looking for a friendly habitat. I haven't seen a Cecropia moth for over ten years."

-- Bernard Sherak, Larchmont, New York

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XERCES WORKS WITH NAS ON SOUTHWEST STUDY

In October, Associate Director Jo Brewer received a letter from Mr. L.A. Shelton of Pomona, CA., a Director of the National Audubon Society, asking for an evaluation of a certain 160-acre tract in southwestern New Mexico as a butterfly habitat. Letters were sent to a selected list of 22 lepidopterists who live near or have collected in the area. From this mailing 13 replies resulted, and a great deal of valuable material passed along to Mr. Shelton. Many thanks to all of you for sparing time from busy schedules to help. Mr. Shelton's reply follows:

"National Audubon is hoping very much that we can justify acquisition of this property, but we can probably do so only if we feel that the very comfortable facilities on the ranch would be used with some frequency by scientists (including enthusiastic amateurs) who want to do some studying in the area. We would maintain guest facilities, and we would rent them at a small charge to people who reserved in advance. The users would have to do their own cooking and bring their own linen, but they would find an idyllic spot.

"If we do acquire the property, I will let you know, and there would probably be oppoetunities for members of your Society to use the property on field trips."

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POLITICS
Society Submits Statements for Public Hearings

One of the major functions of the Xerces Society is to provide a clearing house for information which may influence decisions on land use affecting lepidoptera populations. The preceding article illustrates this function. Recently, the Directorhas been called upon to prepare statements for several political issues of a land use nature, each with butterfly implications. Employing data garnered from Xerces specialist members and contacts, statements were submitted on these issue

Proposed Auburn Dam in California: Area Activist Jerry Powell informed us of this addition to the Central California Project, the completion of which would inundate habitat which local studies have shown to be exceptionally rich for butterflies, including several extremely local species. Since the project is widely regarded as detrimental to the public interest anyway, the Society strongly opposed it.

Open Space in the Green River Valley: This important agricultural lowland south of Seattle, Washington, depreciates yearly from industrial and residential growth. Scarcity of good farmland near the metropolis and open space interests are beginning to align the public reason against the tax pressures for development here. Xerces,

ON THE WING (Continued) POLITICS:

already involved in the area due to the proximity of the Big Soos Reserve, was alerted to the impending attrition of important habitat for the Sara Orange Tip butterfly by Ms. Linda Anchondo. We responded, urging protection

Wilderness in Olympic National Park: Hazel Wolf of the Seattle Audubon Society alerted us that hearings were taking place for the National Park Service's Wilderness designation policy for Olympic. Xerces members have a genuine stake here, as the ONLY colony of *Oeneis chryxus valerata*, the tawny Valerata Arctic, occurs in the park. What's more, the wilderness proposal under consideration deleted the chief locale for *valerata*, naming it a possible site for future development. As the butterfly may be nearly restricted to the precise area left out of the plan, our statement sought to inform the Park Service of the ecological importance of the locality and the apparent mandate to revise the plan to include Hurricane Ridge's wilderness outliers. We are certain the Park Service will welcome the information as the US Forest Service has done on several previous issues.

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XERCES PEOPLE

Members: The members, who are the substance of the Xerces Society, are listed in the first regular Membership List. The list, enclosed with this issue, was edited by Jo Brewer. Prospective members should write Ms. Brewer at 300 Islington Rd., Auburndale, MA. 02166.

Area Activists: Members with special knowledge, interest or enthusiasm for butterfly conservation in their regions or localities may be designated Area Activists. These individuals will try to be aware of special problems or issues in their areas; they will gather information about these issues, inform the directors, and work on the ground with other local members to achieve protection for the butterflies or habitat involved. A list of Area Activists so far designated will appear with the next issue of the newsletter *Wings*. The title Area Activist replaces State and Local Focal People, designations which were not met with general favor.

Chief Counsellors: The Chief Counsellors, chosen from among serious lepidopterists with experience in conservation, liaise with the directors on matters of policy and important issues. A mechanism for providing succession of Counsellors is under study. Presently, the Chief Counsellors are F.Martin Brown, Charles V. Covell, Jr., John C. Downey, Scott Ellis, Ivy LeMon, David McCorkle, George Rawson, Charles L. Remington, William B. Sieker and John Sorenson.

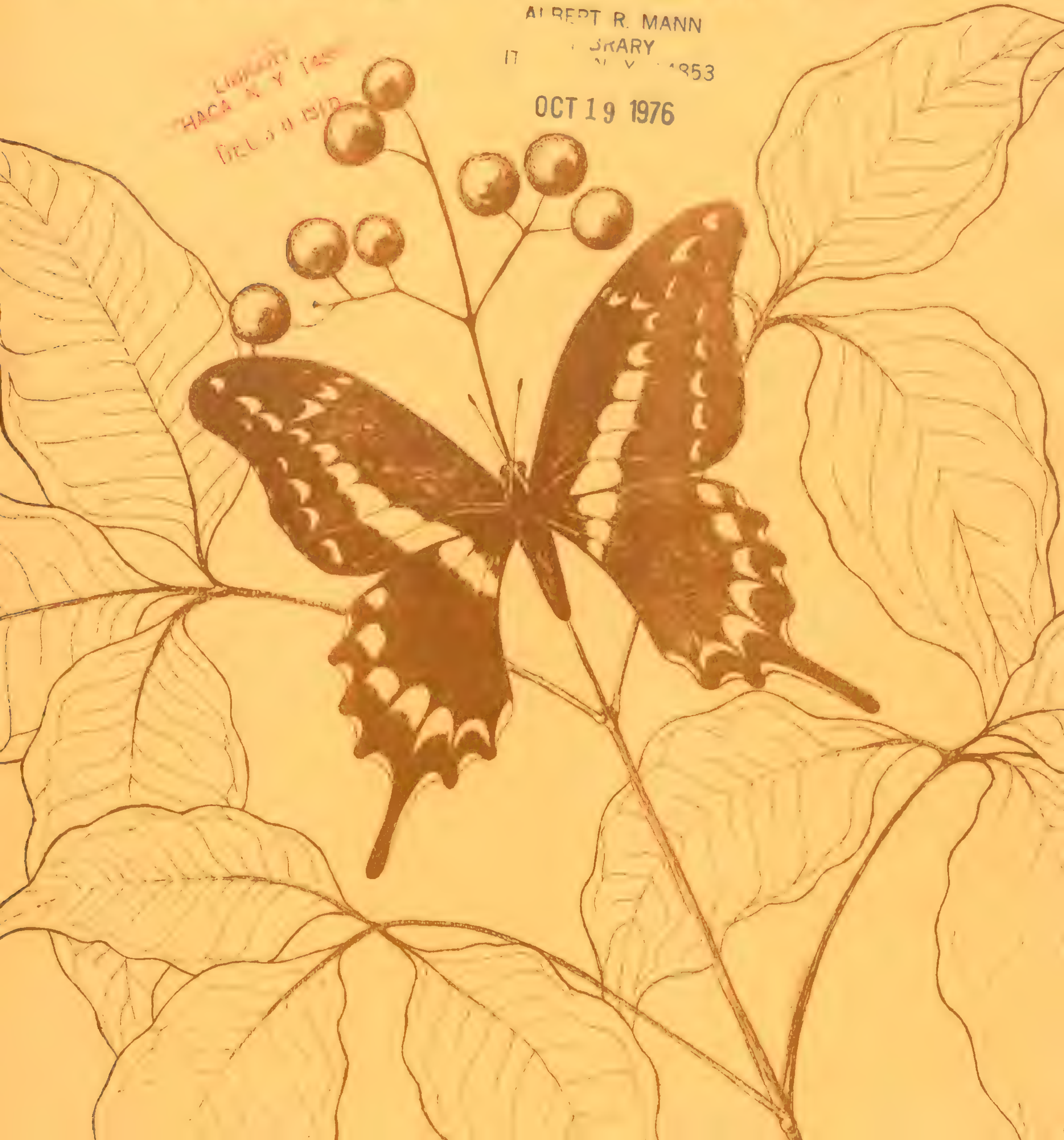
Honorary Counsellors: We are delighted and honored to announce the kind acceptance of the post of Honorary Counsellor by the Hon. Dr. Miriam Rothschild. Dr. Rothschild, a distinguished British entomologist, has a special conservation interest in world trade in butterflies. She joins the following additional respected persons, all with genuine concern for butterfly conservation, in the role of Honorary Counsellor: Dorothy Bradley, Margaret Murie, Roger Tory Peterson, Nathaniel Reed and Edwin Way Teale.

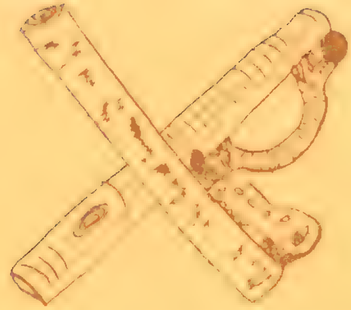
Directors: The Associate Director and editor of the newsletter *Wings* is Jo Brewer, 300 Islington Rd., Auburndale, Ma.02166. Robert Michael Pyle, School of Forestry and Environmental Studies, New Haven, CT. 06511, is Director and editor of this publication.

PLEASE SEND NEWS, ARTICLES AND COMMENTS TO THE EDITOR AT THE ABOVE ADDRESS.

ATALA

VOLUME 2 No 1 JUNE 1974





ATALA

Editor Robert Michael Pyle

Atala is the formal communication of the Xerces Society, an organization for the conservation of rare and endangered butterfly and moth populations. Named after the extinct Xerces Blue, the Society is open to all who share its concerns. Our aim is to work politically and educationally for the conservation of microfauna, especially butterflies and moths. Protection and management of habitats constitute our chief objectives and tools.

Members, who represent each U.S. state and some twenty other nations, receive *Atala* twice yearly as well as the newsletter, *Wings*, which is published quarterly. Dues, effective for the next *Atala*, are $2 annually for students and $4 for others. Please address membership inquiries, dues, other donations (always kindly solicited) and news items to Jo Brewer, 300 Islington Road, Auburndale, MA. 02166. Jo is Associate Director and Editor of *Wings*. Matters of conservation policy, new issues, and requests for society support, as well as material for *Atala*, should be addressed to Robert Michael Pyle, School of Forestry and Environmental Studies, Yale University, New Haven, CT. 06511. Bob is the Director and the editor of *Atala*. Immediate address: Rocky Mountain Biological Laboratory, Crested Butte, Colorado, 81224.

The peripatetic (in summer) directors apologize for any inconveniences or delays in communication or action attributable to their peregrinations.

"I want you to hear
the scream
of the butterfly."
The Doors

"Mike and Megan were happy. They thought sure the world would never be bad while people care what happens to the moths."
Irene Cockroft, *The Moths*

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COVER ILLUSTRATIONS, front and back, are by SARAH HUGHES. Sarah is a member of the Xerces Society from Bath, Avon, England. Her drawings represent Schaus Swallowtail (*Papilio aristodemus ponceanus*) and Torchwood.

COVER BUTTERFLY

by Charlie Covell

The Schaus Swallowtail, *Papilio aristodemus ponceanus*, is now regarded as a subspecies of a butterfly originally described from Cuba. William Schaus described *ponceanus* from specimens taken in the Miami, Fla., region in 1898. It has narrower yellow areas on the forewings than other Antillian populations, and has been taken only in the areas of Miami and the upper Florida Keys. It is a denizen of dense hardwood hammocks through which it wends its way with alacrity, and where its primary foodplant, Torchwood (*Amyris elemifera*) grows in clearings or along paths. Good articles on the life history and habits of ponceanus are "Place of Sorrow" by Florence Grimshawe (1940, Nature Mag., vol. 33, p. 565), and "Observations on *P. a. ponceanus*" by Frank Rutkowski (1971, *Journal Lepid. Soc.*, vol. 25, p. 126).

This elegant butterfly is apparently single-brooded, and emerges as an adult in the latter half of April and flies well into May. I have one record of a battered female taken in March, however - an enigma that has long puzzled me. They are easy to catch when flying along paths or sipping nectar; but often they stick to the heavy woods where capture is more difficult. At this time the species is known to exist in the United States in the government-protected keys of Biscayne National Monument, and also on Key Largo, where collectors take a heavy annual toll. Also, numbers have been reduced there in 1973 and 1974 because the spring rains were absent or nearly so - an important factor in population dynamics of this butterfly. Steady burning over and clearing of the magnificant stretch of subtropical hardwood hammock on Key Largo is also playing an important part in reducing the overall population, I fear. My attempts to discover *ponceanus* on Florida-owned Lignumvitae Key in 1973 and 1974 have not been successful, but the foodplant

is plentiful there and that would be a second suitable preserve for this popular Papilio.

In her 1940 article, Mrs. Grimshawe made ponceanus appear to be an extremely rare butterfly. Appeals for its conservation may be seen in Klots's Field Guide to the Butterflies (p. 174) and other works. Unfortunately any indication of rarity in anything desirable to collectors only brings certain vulturous individuals down on that object to "clean up", since anything rare has monetary value. Adults, larvae, and eggs of ponceanus have been taken for sale, and I have heard all kinds of wild prices asked for these butterflies. One I know of for sure is $10 for males and $25 for females. Although one deplores this kind of exploitation, there is no real way to stop it. We can at least feel a bit better knowing that the population in Biscayne National Monument was relatively healthy in 1974, and that Park officials have its conservation well in mind.

I believe that ponceanus is restricted in its range in the U. S. to the extent that it could become extinct here if climatic conditions were adverse enough to reduce its population below a critical level. It is more in danger of disappearance from Key Largo than from the more northerly Biscayne Nat. Monument. I feel that if winter and spring rainfall are better in coming years, we may see this species even common in its known range, as it certainly was in 1970, 1971, and 1972.

Charles V. Covell Jr.

Charles V. Covell Jr. teaches biology and entomology at the Univ. of Louisvill Kentucky, and is a Chief Counselor for the Xerces Society. He has long been an active lepidopterist, and has for some years been interested in the butterfly fauna of southern Florida. He and George Rawson published a paper entitled "Project Ponceanus: A report on first efforts to survey and preserve the Schaus Swallowtail (Papilionidae) in southern Florida" in Journ. Lepid. Soc., vol. 27, pp. 206 - 210 (1973).

THE KARNER BLUE BUTTERFLY*

1 - wing upper surfaces of male
2 - wing upper surfaces of female
3 - wing under surfaces of male
Blossom of wild blue lupine
All natural size.

BLUE BUTTERFLIES OR BULLDOZERS?

Albany's Pine Bush is threatened, and with it, a rare and beautiful butterfly.

THE PINE BUSH COMMUNITY

Bleak. Desolate. Worthless. Wasteland. These are usual assessments made of the Karner Pine Bush by people unfamiliar with the plants and animals that occur there. But those who understand the region's ecology find it a fascinating place to visit and study.

The Pine Bush (variously known as the "Karner Pine Barrens," "Albany Sand Plains," "Albany Pine Bush," "Albany Pine Barrens," or just as "Karner" and formerly as "Center") is an unusual ecological community lying on either side of the New York State Thruway between Albany and Schenectady. It is so dramatically different from the normal deciduous forest cover of upstate New York that its demarcations are instantly apparent to anyone familiar with common trees and plants of the Northeast.

But the average resident or traveller in the region often does not even notice the difference, and what is worse, he may not care.

Why *should* he care? Because the Pine Bush is a unique association of interesting plants and animals that is rapidly being destroyed by man's activities, and because a rare and beautiful butterfly, the Karner Blue, faces extinction there.

Present uses of the Karner "wasteland" are mostly exploitative. Lying between two major cities, it is rapidly being engulfed by suburbia. Several dirt pits evidence the removal of its loose, sandy soil for construction concrete. The massive City of Albany landfill yearly gobbles more and more acres, leaving bulldozed stretches of bare sand. Dumping garbage from private vehicles is easy along the network of roads -- the Pine Bush has been much defiled in this manner. Motorcycling has eroded the banks and killed the vegetation.

This Karner region is also prime real estate. The electric cable markers, fire hydrants, and surveyor's stakes that line the roads tell of near-future developments. Sign after sign advertizes land for sale, or proudly announces "The Future Home of...."

Lycaeides melissa samuelis

To the handful of naturalists who truly understand it, the Pine Bush is much more than just a place to dump garbage. Strolling down a sandy road, one is able to gain an appreciation of the special association of plants and animals that make this region so different from anywhere else on earth.

The first impression one gains is of distinct *layers* of vegetation. The "canopy" is of pines -- pitch pines with three short needles in a cluster and oval, two-inch-long cones with a sharp prickle on each scale. The pines grow to 40 or 50 feet tall, their often fire-blackened trunks averaging a foot in diameter at breast height. In some places the trees grow sparsely, in others they are more closely spaced.

The next layer of vegetation is a scrubby tangle beneath the pines that pretty well covers the rolling sand dunes and intervening open spaces throughout the area. Major constituents are scrub oak, blueberry, sheep laurel, thorny black locust, raspberry, blackberry, New Jersey tea, and occasional grapevines, sumacs, aspens, pussy willows, juneberries, fire cherries, grey birches, and wild rose* and plum bushes. Maximum height of these shrubs is about eight feet. They are so thick that it is nerve-wracking to try to make one's way through them for very long.

A few herbs grow in and among the scrub layer, but more kinds live in open places. These are all hardy plants that can survive on harsh, acid soils -- mosses, lichens, wintergreen, grasses and sedges, wood lilies, rue anemones, bracken ferns, goat's rue, and most spectacular of all, the wild blue lupine.

The soil itself is sandy and deep, like fine beige sugar. It seems like a beach without its ocean.

What animals live in the Karner Pine Bush? There are many. The scrub thickets provide shelter and abundant browse for cottontail rabbits. Chipmunks and ground hogs can easily excavate burrows in the soft soil. An occasional white-tailed deer is seen. Red-tailed hawks float overhead, seeking out small rodents. Eastern bluebirds* and blue jays flash their lovely colors against the pine branches. Towhees rustle dead oak leaves with their scratchings, and wheezily call their names. Chickadees announce themselves from the pines, and an occasional mourning dove, almost the color of the sand, is startled into flight.

Domed ant nests protrude through the litter, ladybird beetles crawl up grass blades, and tiger beetles zap away, flashing burnished bronze elytra. Over twenty different kinds of underwing moths carry out their secretive lives among the trees and shrubs, in addition to buck moths, geometrids, and others. Unusual small brown butterflies called elfins abound, their larvae feeding on the lupine, blueberry, pine, and sheep laurel. Hairstreak skippers, little wood satyrs, and several other butterflies can be observed at flowers or around their foodplants. And if one is very lucky, a Karner Blue butterfly may be seen, flying near lupines or landed at a puddle along the sandy road.

(*State Flower and State Bird of New York)

Periodic natural fires rage through the Pine Bush, leaving ugly, black scars on the landscape. But Nature is quick to heal a wound. Luxuriant suckers sprout from the rootstocks of the oaks and other plants, and soon everything is green again. In fact, the fires are important in retaining the characteristic scrub oak-pitch pine plant association of the Karner region.

WILD BLUE LUPINE

One of the loveliest herbs of Karner is the wild lupine, a plant that grows only on sandy soils. Since it is the main food-plant of the Karner Blue butterfly (three others are very rarely used), and because its presence at the Pine Bush is the reason for the butterfly's occurrence there, it is important to know a few facts about it.

To botanists, this lupine is *Lupinus perennis*. The *perennis* part of its scientific name is easy enough to explain: Lupine is a perennial, sprouting each year from an underground rootstock. But the origin of *Lupinus* is more interesting. Early settlers noticed that land where lupines grew was poor for agriculture. Believing that lupines robbed the soil of its fertility, they named them after the wolf, *lupus* in classical language. This name is a complete paradox, however, because lupine, being a legume, bears the small swellings on its roots which contain tiny organisms that can take nitrogen from the air and convert it to a form useable by plants. Thus lupines actually *enrich* the soil where they grow.

A patch of wild lupines in full bloom is a sight to see! Growing in 1 1/2-foot-tall clumps, the plants sprout in late April and flower a month later. The blossoms are usually some shade of purplish-blue with touches of white, but rarely may be pure white or magenta. They are clustered along a terminal shoot, looking very much like a cultivated sweet pea's or russelli lupine's flowers.

Lupine leaves are extraordinary, like tiny, green umbrellas. A beautiful pubescence (hairiness) covers them and their thick, watery, purple-tinted stems. Newly-unfolding leaves are often also tinged with maroon. Lupine is sometimes called the "sundial plant" because its leaves turn to face the sun as each day progresses.

Lupines have a very extensive root system, which makes them difficult to transplant successfully. The seeds are borne in a pod, like a garden pea's. They thrive in open spaces throughout the Pine Bush, but in places also grow beneath the pines or in other more shaded spots.

THE KARNER BLUE BUTTERFLY

This butterfly has had an almost legendary association with the Karner region for over 100 years. It is still the most famous and was once the most characteristic insect of the Pine Bush. Specimens caught there rest in the great butterfly collections of the world. Wherever North American butterflies are studied, the Karner Blue is known.

As its name implies, the Karner Blue is colored a deep, purplish-blue on the upper surfaces of the wings. This is set off by a black border (wider in the female) and beautiful white fringes on all four wings. Beneath, the coloring is very different -- pale grey with black, white-rimmed spots and a row of orange and metallic sky-blue markings near the hindwing edge. Its delicate coloring and small size (wing expanse is about an inch) make the Karner Blue one of New York's most exquisite butterflies.

The yearly life cycle of the Karner Blue begins in late May and early June, when first brood butterflies appear, flashing their brilliant, blue wings among the azure, fragrant lupine blossoms. Soon the females lay tiny, greenish-white eggs on lupine leaves.

One week later, small caterpillars or *larvae* hatch from the eggs and begin to eat the leaves. Instead of chewing through the entire leaf, as most butterfly caterpillars do, the Karner Blue's larvae have a characteristic habit of eating all but the upper cuticle, leaving translucent "windows" in the leaves. After a month of feeding in this fashion, they are plump, velvety-textured, and exactly the color of lupine leaves.

People finding the Karner Blue's larvae in the wild have often noticed ants clustering thickly about them. This is because each caterpillar has a tiny, nectar-producing gland on its body. Ants attend the caterpillars, apparently protecting them from parasites (none have been recorded in 115 years) and predators, in exchange for an occasional taste of the sweet fluid. A pupa was even found with an ant guarding it! Similar relationships with ants are not uncommon among other butterflies of this family.

When ready to form a chrysalis, each caterpillar spins a pad of silk in some sheltered place. After several hours, a pea green chrysalis forms, attached to the silk mat by tiny hooks at one end and by a silk belt around the middle. As the butterfly develops within, the wing covers change from green to salmon to deep blue-black. After ten days, the pupal shell splits open and a new Karner Blue emerges and expands its wings.

This second brood of butterflies appears in late July and early August. Again the females lay eggs. Since partly-grown caterpillars have been found both in October and mid-May, they undoubtedly overwinter, although this has never been definitely proved. In any event, new butterflies are on the wing during May and June of the following year, to begin again the annual cycle of two broods.

WHAT OF THE FUTURE?

In the early part of this century, a vast sandy plain existed in what is now the western part of the City of Albany. Acres of flowering lupines waved in the wind in May and June, and millions of Karner Blues fluttered above them so that the air fairly shimmered with their glinting wings. It was possible to catch over 30 of the beautiful little creatures with a single net sweep. Today, these multitudes of lupines and butterflies are gone. In their place, cars zoom by on superhighways, people relax on well-manicured lawns, college students stroll to classes, and important officials deliberate in offices.

The few surviving Karner Blues at Albany now live in the adjacent Pine Bush where some lupines still grow. But they never again can thrive in the numbers they once did, because their habitat will never again be the same. And this most famous butterfly of the Albany area may shortly become extinct at its most famous locality, as the Pine Bush continues to be destroyed beneath the bulldozer's blade.

Elsewhere in New York State, the Karner Blue has been recorded from about eight locations. Most of these records predate 1900, and in all but three places (Karner one of them), the butterfly hasn't been seen for many years. It surely must be extinct on Manhattan Island and in Brooklyn, where it once occurred. The only New York State colony we know of that has a reasonable chance for survival is near Buffalo.

There are a few old records from Massachusetts, New Hampshire, Ohio, northern Illinois, and Ontario, Canada. We have no information on its current status in these places. It has been seen within the last 15 years in four counties of northeastern Pennsylvania, in three places in northern Indiana, and in a handful of localities in Michigan. The Karner Blue is always a very local butterfly, occurring only in small isolated colonies where lupines grow on sandy soils. The places mentioned above comprise its known range.

The situation at Hessville, Indiana, just outside of Chicago, closely parallels the decline of the butterfly at Karner. According to a well known Chicago lepidopterist, there is one isolated colony of the Blue left there in a 100 foot x 100 foot area that very likely will soon be bulldozed bare.

One encouraging fact, however, is that a few Karner Blues were found several years ago at the Indiana Dunes State Park at Tremont, where no development is permitted. We have no recent information on its status there. It is also "alive and well" in a few places in Michigan, including a State Game Area. But as with all butterflies that feed on one species of plant growing in a rare kind of habitat, the Karner Blue is very vulnerable. Many sandy areas with extensive stands of blue lupines in the Northeast occur, by coincidence, along waterways where large cities have grown up during the last two centuries. And it seems that nearly always, when man and butterflies try to occupy the same place, the butterflies are the losers. A classic example is the Xerces Blue, a close relative of the Karner Blue, which once occupied the coastal sand dunes at San Francisco, California. It has been extinct for 30 years -- ever since its habitat was completely destroyed by man.

At the Karner Pine Bush, the Karner Blue's decline is not due to increased numbers of parasites -- as far as we know, it has none. It is not due to competition with other lupine-feeders. Other herbivores that eat lupine feed on different parts of the plant (flowers or flowers buds, and fruits, rather than leaves) or at different times of the year, and therefore do not directly compete with the Karner Blue's larvae. There seems to be a sufficient supply of lupines at Karner, but not the acres there once were. Perhaps huge amounts of the foodplant are required for the butterfly to thrive. Collecting of a few specimens here and there by lepidopterists, although often blamed as the cause of a rare butterfly's demise, is usually insignifigant when compared to habitat destruction. This is the major butterfly killer.

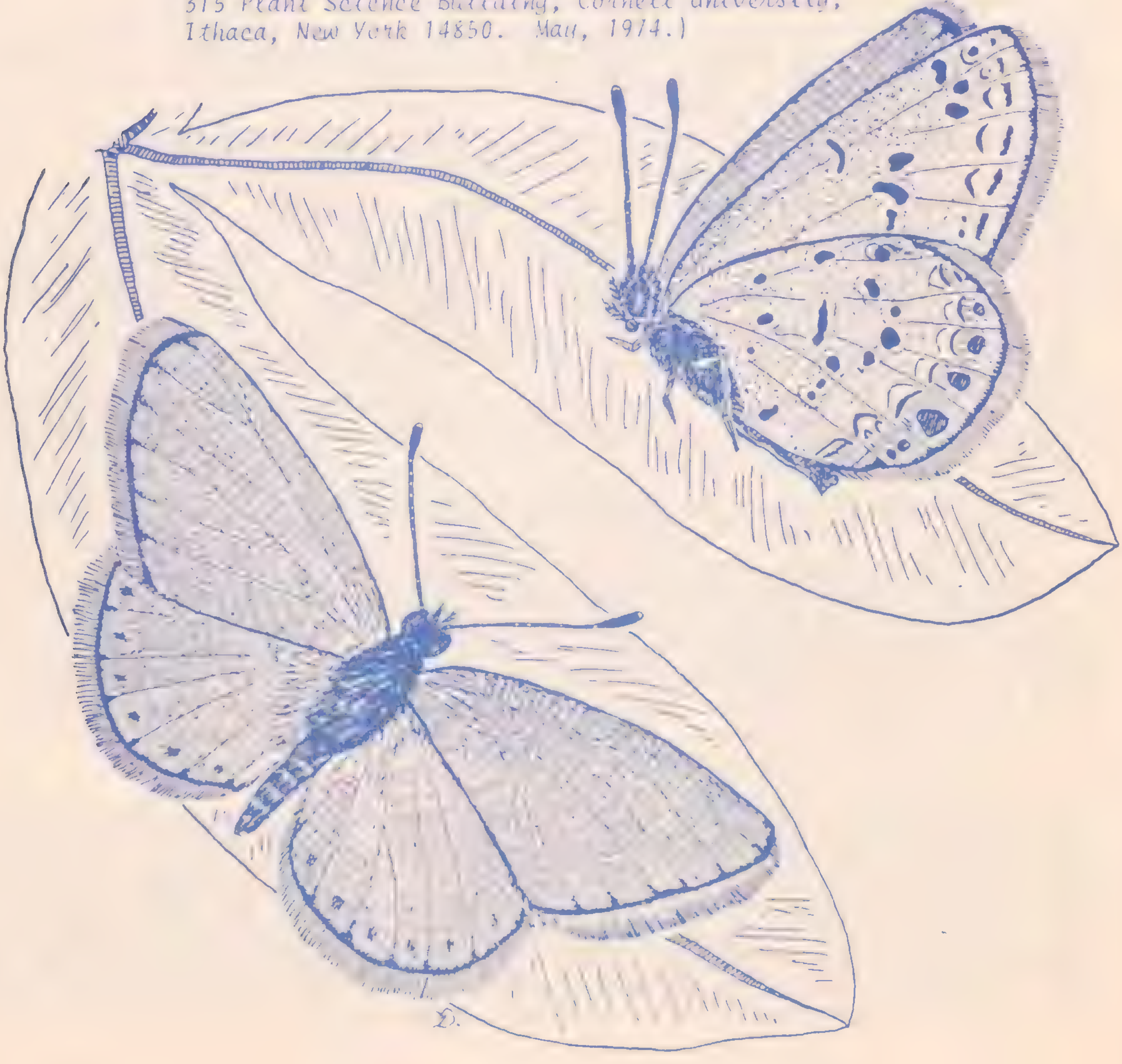
Since January, 1973, the Xerces Society (address: Jo Brewer, Associate Director, 300 Islington Road, Auburndale, Massachusetts 02166), named for the Xerces Blue and dedicated to the conservation of butterflies and their habitats, has sponsored the Karner Blue Project. Several lepidopterists have closely studied the butterfly and its habitat. A plea for its preservation and for saving a few acres of the remaining Pine Bush appeared in the October-November, 1973 CONSERVATIONIST magazine, and in the September, 1973 issue of NYS ENVIRONMENT, both published by the New York State Department of Environmental Conservation. Public lectures on the butterfly and the Pine Bush have been

given at the New York State Museum, Yale University, and several times at Cornell University. The Xerces Society is cooperating with the Eastern New York Chapter of the Nature Conservancy, headed by R. T. Petersen of Schenectady, in trying to establish a Pine Bush Preserve where the Karner Blue might have a reasonable chance of surviving. Some people who live on the edge of the Pine Bush now cultivate large patches of wild lupine in hopes of attracting the beautiful blue butterflies to their gardens.

Of course, the growth of urban areas cannot be completely curtailed, and this is unreasonable to expect. But it is not unreasonable to ask that butterflies, as well as other wild animals and plants, be considered when plans to develop new areas are made, especially when something as distinct and precious as the Karner Blue is involved. It is necessary for far-thinking people to help preserve these rare members of our fauna while there is still time.

Officials of the City of Albany and suburban Pine Bush communities of Colonie, Guilderland, Bethlehem, and New Scotland should know about this precious natural heritage they so carelessly guard, and unknowingly allow to be destroyed. Please write, urging them to save the Pine Bush and Karner Blue today.

(Prepared for the Xerces Society by Robert Dirig, 315 Plant Science Building, Cornell University, Ithaca, New York 14850. May, 1974.)



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ABOUT THIS BIBLIOGRAPHY: In the previous issue of Atala, we promised a series of self-help sheets --tools for butterfly conservation which could be used directly by members for their own projects and awareness. As the first installment, this catalogue of relevant literature is intended to include all those materials which have come to my attention in several years' study in this field. While I am sure it is incomplete, I have included everything I have found which expresses interest in the basic question of Lepidoptera conservation, including some unpublished materials of importance and some non-Lepidopteran articles which may prove useful. Any errors and omissions in citations are my own. Thanks be to Dr. Charles Remington and the libraries at Kline Biology Tower, Yale University, and the Royal Entomological Society, London, for their help. Further references and reprints, comments and corrections are ardently solicited.

Robert Michael Pyle, Editor

A male Panchala ganesa loomisi, family Lycaenidae (x1). This butterfly has light blue patches in the center of its black wings. The wing undersurfaces are pale brown. The female is similar to the male, but the light blue areas of her hind wings are more extensive. This butterfly is very rare in Japan now.

PROTECTION OF BUTTERFLIES IN JAPAN

by

池沢常吉 -- Tsuneyoshi Ikezawa

People often remark, "Butterflies aren't as common as they used to be, are they? I don't see many in my area anymore." Indeed, butterflies have decreased, especially near Japanese cities, because of urban and suburban expansion. As a result of developments, the foodplants of butterflies are destroyed, and insecticides are used to exterminate insects man considers harmful -- and butterflies are innocent victims. However, I don't think our butterflies have decreased appreciably in mountainous regions which are as yet undeveloped.

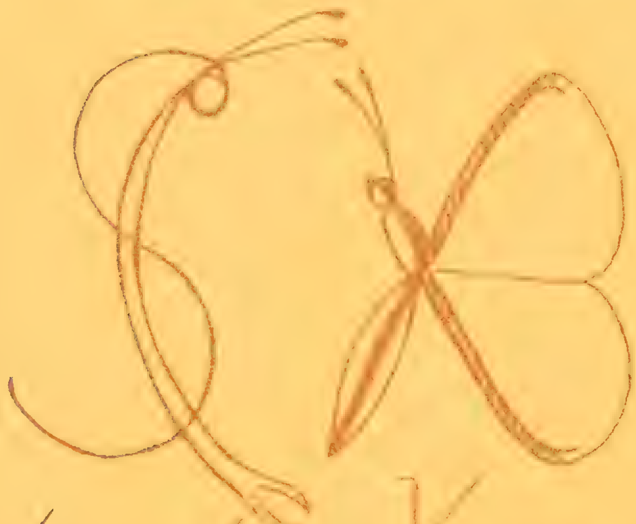
Some people blame collecting for the decrease in our butterflies. Although we cannot say that collecting has no effect, its importance is usually exaggerated. Limiting of a butterfly's numbers by over-collecting can be cited only in rare cases involving a particular species, and is generally insignificant when compared to the developing of property (and therefore the destruction of habitat) or applying an insecticide indiscriminately. We have had enough experience to know that the thinning out of insects to a certain degree by collecting has little effect on the species as a whole.

In Japan, we have some rare and scientifically valuable butterflies which occur only on natural monument lands. The Tailless Bushblue, Panchala ganesa loomisi, which is found at Kasugayama, Nara-ken, is one of these. Collecting of this butterfly is forbidden by law, because officials believe that collecting butterflies is the main factor that reduces their numbers. Even so, the Tailless Bushblue is said to be very rare, and is scarcely found even at Kasugayama, Nara-ken. The reason is plain: Its habitat is not protected! If we clear its habitat and cut down its food tree, this butterfly cannot survive. Therefore, Panchala ganesa loomisi is nearly extinct in Japan.

The most effective way to protect butterflies is to stop man's interference in natural areas. However, in a small, crowded country like Japan, it is impossible to stop land developments, and this is unreasonable to expect. But it is not unreasonable to ask that butterflies and other wild animals and plants be considered when planning developments. We need not worry so much about species with a wide distribution, but we should be especially concerned about those butterflies with a limited range or specific habitat requirements. It is possible to preserve these butterflies while scarcely affecting a development proposal. Most people in charge of developing land are not concerned with the protection of nature. They do not understand the importance or value of the plants and animals that live on the land they want to develop. If this situation is left as it is, scientifically valuable living creatures of Japan may become extinct in the near future.

-- Reprinted with thanks from TIEG Newsletter

Butterflies are free . . .



but Xerces isn't.

IT WOULD BE NICE if butterflies really were free. But saving them costs money. So does printing the news about them, and especially mailing it.

SOMETIMES PEOPLE who don't know about butterflies, when I tell them about Xerces, ask me, "Well, is there any money in it?" I tell them, "No."

True, we've received some kind grants and contributions lately from other people, who don't equate butterflies with plastics. We've even given a grant to Larry Orsak, to search for the presumed extinct Atossa Fritillary. And with the help of conscientious lawyers like Bill Sieker and another whom John DeWind has rounded up, we're quite near applying for tax-exempt status. And that will help. But even so, we'll be nie onto busted after this issue is printed and mailed.

Therefore and henceforth, it was decided at the First Annual Meeting to abandon beneficence and to institute dues. Four dollars a year for regular people, two dollars for students. Here's the deal: If you have already made a donation, you're clear for '74. If not, send dues now for the next Atala and the next two Wings. And then fresh dues from everyone in 1975. (Eastern European members exempted.) Please remember that larger donations are always kindly solicited, especially now that the Xerces logo is spreading her pheromones, hoping to catch that big dollar sign in the sky.

AND...WE NEED A QUALIFIED TREASURER! IS THIS YOUR NICHE?

The Communication of the Xerces Society

ATALA

VOLUME 2.
NUMBER 2

DECEMBER 9
1974

COVER FEATURE: *Catocala pretiosa*

Animals of great delight and mystique to many persons are the underwing moths of the genus Catocala. With their darker primaries and magenta, scarlet, chalk or orange secondaries, the underwings present a visual paradox to potential avian predators. At first confoundingly camouflaged, then strikingly but unmistakably apparent, these masters of delusion appeal to all kinds of natural persons who come to know them. Their ethological strategy fascinates scientific heterocerists, while their sheer beauty and variety captivates the fancy of the naturalist. As W.J. Holland puts it in his famous essay, 'Sugaring for Moths,' from The Moth Book, 'What is there? Oho. My beauty. Just above the moistened patch upon the bark is a great Catocala!'

Of all the catocalid characteristics which enthrall us, perhaps the most poorly understood is their ecology. Records are available for many years back, thanks to their many admirers and collectors. It seems that the underwings undergo great fluctuations in numbers from year to year, as well as shifting patterns of occurrence. This leads to at least an impression of rarity for many of the species, and some appear to be absent for years at a time. One of these, which was not reported at all for nearly four decades, is the moth illustrated on our cover, Catocala pretiosa. In the last six years, however, several new captures have been made of this once presumed-extinct organism. What is its real status, and is conservation really at issue with these insects? Some answers may be forthcoming. Dr. Theodore Sargent of the University of Massachusetts will soon publish a popular book on the Catocalas, with a goal of communicating many aspects of their biology and ecology to the larger public. And in the next issue of Atala, Dale Schweitzer will be reporting on Catocala conservation ecology.

* *

MOTHS ARE [illegible] INSECTS!: Some of our butterfly purist readers may revolt, but we hope most of you will share our enthusiasm for the broader scope of interest reflected in this issue. As for birds ravishing underwing moths and mantises munching Monarchs, well, even 'good' insects do get eaten. And that is one of their utilities in nature. But fear not, we are still on the side of the bugs and we shall continue to encourage and carry out the conservation of populations of butterflies and moths in every way we can.

Toward the objective of extending our interests and efforts to embrace all beneficial microfauna (at least terrestrial arthropods), we have produced an issue of Atala which butterflies, still paramount, must share. We hope you will find it interesting to read, and we thank all the contributors of words, ideas and pictures for helping to make it that way.

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COVER: Our cover illustration and art deco titles again present the artistry of SARAH HUGHES, who drew previously the Schaus' Swallowtails for the front and back covers of Atala 2:1. Sarah, a British citizen, now resides in New Haven where she draws as well as works in the Yale Peabody Museum and New Haven Colony Historical Society Museum. Having obtained her BSc in Plant Sciences from the University of Bath this year, she hopes to do graduate work in Museum Studies in the future. Ms. Hughes was married in Bath on June 7 to Bob Pyle, Xerces Society Director.

The back cover bears a remarkably appropriate drawing by Tony Angell, of Seattle, from his book Owls (University of Washington Press, 1974).

ATALA, VOLUME TWO, NUMBER TWO. This is the Third Anniversary number, published December 9, 1974, in New Haven, CT. Address all correspondence concerning this magazine to the Editor, Robert Michael Pyle, School of Forestry and Environmental Studies, Yale University, New Haven, CT. 06511. Membership in the Xerces Society includes Atala twice yearly. Dues for new members ($4, $2 student) may be sent to Associate Director Jo Brewer, 300 Wellington Rd., Auburndale, MA. 02166. Conservation issue mail to the Director, who is the Editor of Atala.

ABOUT MOTHS

"The moths are the heralds or, better yet, the guardians of eternity... For some reason, or for no reason at all, they are the depositories of the gold dust of eternity...The moths carry a dust on their wings. That dust is the dust of knowledge."
--Don Juan in Carlos Castaneda, Tales of Power

The poet knows
As moths know
Long before us.
--Arlene Stone, "The Night They All Took Time to Praise the Farah Workers"

But see! a wandering Night-moth enters
Allured by taper gleaming bright,
Awhile keeps hovering round,
then ventures
On Goethe's mystic page to light.
--Thomas Carlyle, "Tragedy of the Night Moth"

Moth, art thou sped?
Dim as a ghost he flies
Through the night's mysteries.
--Ellen Mackay Hutchinson Cortissoz, "Moth Song"

That not a worm is cloven in vain
That not a moth with vain desire
Is shrivelled in a fruitless fire
Or but subserves another's gain.
--Tennyson, In Memoriam

"Much of the country is now ablaze with mercury vapor lights at night, and there can be no doubt that countless millions of moths are thus lured to their destruction."
--Douglas C. Ferguson, Moths of North America (20.2A)

"Yet the power was there all the same, massed outside indifferent, impersonal, not attending to anything in particular. Somehow it was opposed to the little hay-coloured moth...when there was nobody to care or to know, against a power of such magnitude, to retain what no one else valued or desired to keep, moved one strangely. Again, somehow, one saw life, a pure bead."
--Virginia Woolf, "The Death of a Moth"

"Mike and Megan were happy. They thought sure the world would never be bad while people care what happens to the moths."
--Irene Cockroft, The Moths

NOTICE

SECOND ANNUAL MEETING
****

The Second Annual Meeting of the Xerces Society will convene at Cornell University, Ithaca, New York, from April 25 to 27, 1975. According to Program Chairman Robert Dirig, the Society will be warmly welcomed by the university and its many entomologists. Cornell, one of the true seats of insect studies and all natural history in this country, will be an especially exciting place for members to visit. Again, following the First Annual Meeting at Yale, we are fortunate to have another particularly appropriate place to gather. Tentatively, the program will include such authorities as Dr. Paul Opler and Dr. Paul Pheeny, as well as Cornell student John Cryan speaking on Saturniidae. Mr. Dirig plans to present a workshop on rearing Lepidoptera, and a field trip will certainly be included -- hopefully to see the scarce _Pieris virginiensis_. Announcements concerning travel, housing and other details will appear in the next issue of _Wings_, or in a special mailing. Special questions should go to Robert Dirig, 334 Plant Science Bldg., Cornell University, Ithaca, NY 14850. Plan now to spend a delightful spring week-end with us among the Finger Lakes!

Third Anniversary Gathering

On the day of publication of this issue, December 9, 1974, the Xerces Society marks the third full year's passage since its founding. Celebrating this date along with the eclosure of _Atala_ for its fourth number, the Director, Associate Director, Treasurer and several other members will be meeting today and tonight in New Haven for an interim executive session followed by food and drink.

CHEERS!

Group photograph of Xerces Society members present at the 25th Annual Dinner Meeting of the Connecticut Entomological Society on the eve of the First Annual Meeting of the Xerces Society, April 20, 1974, at the Connecticut Agricultural Experiment Station. Standing, l to r: A.Klots, J. Brewer, J.DeWind, M.Rothschild, F.Chew, H.Raub, W.Winter, C.Remington, K.Brown, P.Miliotis, S.Hessel. Seated: I.LeMon, F.Naas, L. Gali, T.Chester, R.Pyle.

Photograph by Kenneth A. Welch, specially printed for _Atala_ by Meredith Munsey.

Special Thanks to Robert Harold Pyle, of Bostich-Denver, who donated the stapling machine used to produce this issue.

ARTICLES

PROJECT ATOSSA -- PRELIMINARY REPORT

Larry J. Orsak

Introduction. Project Atossa was initiated this year in an effort to rediscover a lost butterfly: Speyeria adiaste atossa (Edwards), the Unsilvered Fritillary. This elusive insect had not been seen by a lepidopterist since 1960, and was rarely sighted or captured in the preceding two decades. Atossa had not always been so rare, however. An exceptionally large colony evidently existed in the past near the rest stop called Sandberg's on the Old Ridge Route (Angeles National Forest). On June 11, 1922, John Adams Comstock, the veteran Southern California lepidopterist, took 500 males and females on the blossoms of the California Buckeye (Aesculus californicus) in a small gully about 500 feet east of Sandberg's. Although this record was never matched, other local collectors also captured considerable numbers of atossa during the 1920's and early 1930's.

While the Sandberg's locality was the only well known atossa haunt, the butterfly was taken in several other places in various nearby mountain ranges. We have a few records for Bouquet Canyon, Voltaire and Caswell's. One record exists for Keene. Several collectors took or sighted atossa near the present-day McGill Campground east of Mt. Pinos (Los Padres National Forest), at Fort Tejon, and in the Tehachapi Mountains, probably in Antelope Canyon. Atossa was, in fact, first taken in 1890 by Burrison in the Tehachapi Range, about four miles from Tehachapi, "in a little valley...by a small stream." This vague description might well refer to Antelope Canyon.

The last known specimens turned up in 1959. These findings occurred at either end of atossa's known range, interestingly enough. Dr. John Garth, an experienced collector, took a male and a female at McGill Campground on June 5, 1959. The late Joe Wilson took another specimen in the Tehachapi Range on July 1 of that year, at an indeterminate locale. In 1960, the very knowledgeable lepidopterist Lloyd Martin reported a sighting on the peak of Mt.Pinos -- the last report of Speyeria adiaste atossa.

The exact kind of habitat preferred by the Unsilvered Fritillary has thus far been rather difficult to define. Surprisingly enough, it ranged over an altitudinal gradient of more than 4000 feet. The lowest known colony occurred near McGill Campground (7500 feet) and on the saddle between Mt. Tehachapi and Double Mountain (7600 feet). These sites both support conifers, notably Pinus ponderosa. Atossa frequently was found in open canyons with water present. It found the flowers of California Buckeye attractive, and nectared as well at other kinds of wildflowers. Many areas throughout the butterfly's former range meet this general description, although atossa seems never to have been generally distributed in these. Thus, the organism was evidently limited by more specific ecological requirements, which are difficult to delineate in retrospect; or else it occupied discrete units which together made up only a small part of the suitable habitat, as some other butterflies are known to do.

Perhaps a specific violet foodplant was the prime factor limiting the distribution of atossa. Unfortunately, most lepidopterists in the 1920's were more interested in finding adults than larvae, and then catching those adults rather than watching them first; so the precise foodplant of the larva is not known for certain. Emmel and Emmel (The Butterflies of Southern California, 1973, L.A.Co.Museum) suspect the host to be Viola quercetorum.

This, briefly, summarizes our knowledge of the Unsilvered Fritillary.

The Search. Our search for S.a.atossa in 1974 consisted of three excursions. The first, in late May, was made in an effort to get a clearer idea of the types of habitat formerly occupied by atossa; to look for violets, which would have died back by the next month; and to chart candidate areas for potential intensive exploration later in the summer. Data obtained from this trip was employed in finalizing the "game plan" for the rest of the survey. We intended to concentrate primarily on areas where the butterfly had been taken and not gamble on likely looking places, unless they seemed especially propitious, for we had a limited amount of time to explore the vast area once roamed by our quarry. The Sandberg's locality did not seem to warrant further examination since it has been thoroughly searched by other collectors in the past two decades with no positive results. McGill Campground interested us particularly, however, it being both undisturbed over the last half-century (or nearly so) and the origin of some fairly recent records. Likewise, Antelope Canyon in the Tehachapi Range and the adjacent saddle have escaped severe damage by fire and grazing, remaining in their natural states. We decided also to explore some intriguing canyons on the Cummings Ranch in the Tehachapis, despite no actual records of the animal from there. In addition, several other sites where atossa once flew were tabled for visitation the following month.

It was difficult to assess the optimum times for surveys to be made. Records of atossa stretch from late April to early September, with most dates clustering from early June to mid-July. We settled on the last ten days in June for our investigation.

Results. I am sorry to have to report that we found no Unsilvered Fritillaries during the first field stage of Project Atossa. Other butterfly life was exceptionally abundant in many of the areas visited, so the weather cannot be blamed. We did uncover some interesting information, which will be conveyed to the Xerces Society. Regarding atossa, it is notable that we observed from one to three other species of Speyeria present in areas where atossa formerly flew. These sympatric populations show no parallel diminution.

Why, then, has S.a.atossa disappeared? More than one hypothesis has been advanced to explain this mystery, none of which seems wholly satisfactory. The most frequently repeated theory states that the severe drought which parched Southern California from 1959-1961, and the drier-than-usual preceding ten years or so, spelled the end for this subspecies of adiaste. Supposedly, the extant populations of atossa were already weakened by overgrazing and brush fires which destroyed the foodplant. Speyeria authority L.P. Grey feels that atossa was simply a weak race which could not adapt to the progressively drier Southern California environment as could the other large fritillaries there. Overcollecting constitutes another popular theory, especially as a factor in the demise of the Sandberg's population which Comstock collected so heavily. While collecting very seldom damages whole populations of flying insects, it can possibly be a threat to pre-stressed colonies such as atossa may have been. Other theories exist and will be discussed in a forthcoming paper.

It should be pointed out that this butterfly had already declined in numbers by 1940 -- almost twenty years before our severe drought. Also, the overall population of the subspecies reflected the descent in numbers, while most colonies sustained reduction by only a few specimens each during twenty years of collecting. In any case, S.a.atossa clearly underwent a dramatic decline in as little as fifteen years, from approximately 1930 to 1945, after which we detect only three records. It seems as though some profound ecological catastrophe befell atossa, from which it never fully recovered. I hope to demonstrate this more fully through careful investigation and correlation of precipitation data, brush fires, and other phenomenological data from atossa's life and range. Indeed, the atossa enigma is one which we must continue to ponder and study.

Project Atossa: The Future. I shall conclude this rather disheartening report by offering my opinions on the prospects of re-discovering atossa and the areas of study in which I feel the Project should maintain emphasis. Local collectors presently are about divided evenly over the prognosis for the insect. Although the Sandberg's locality almost certainly no longer supports the animal, perhaps some of the lesser-known former localties still nurture colonies.

Atossa seems to have been a very local butterfly and with the exception of the Sandberg's colony and perhaps another at Fort Tejon, its populations seem to have been rather small. If a lepidopterist had the time to thoroughly explore an area such as McGill Campground over the course of an entire summer, he might turn up the subspecies. In addition to known localities, many areas exist in the Tejon, Sierra Madre, Tehachapi and Mt. Pinos ranges which might prove suitable for relict units of _atossa_. Much of this country is remote and inaccessible, and (as I found) it is impossible to investigate every potential site in the course of one, or I suspect even several, years. Especially interesting is the area west of Mt. Pinos, which I did not reach during this survey. Others, in their efforts to locate _atossa_,seem to have neglected this region as well. A concerted effort, such as that attempted this year but redoubled and enjoined by others, will be needed over a period of several years before either _atossa_'s epitaph or its existence can be proclaimed with certainty.

Should this latter and preferable conclusion be established, efforts must be made to protect the newly found creature from collectors. While some sampling may be possible after the situation is clarified, a strictly cautionary period should be observed until then. A spirit of cooperation will need to be cultivated among lepidopterists interested in _atossa_, so that the prime interest, survival of the organism, is served above all. Already _atossa_ has a high price on its head. One local collector has offered to sell a specimen of the presumed extinct taxon for $50.00. While insects can normally sustain even heavy collecting, a weak and rare population like _atossa_ might not be expected to survive much longer with a price tag like that, unless vigorously protected. This, of course, would be a job for conscientious collectors themselves to oversee.

However, the chief cause of most butterfly conservation issues relates to habitat. Therefore, if _atossa_ truly is extinct, it would not spell the end of our interest in it. Two other races of _adiaste_ continue to fly in the coastal ranges of California, from Santa Barbara to Monterrey Counties. These are the nominate race _S.a.adiaste_, and _S.a.clemencei_. _Clemencei_ is thought of as the evolutionary link between the other two. If _adiaste_ is indeed a weak species overall, and if the drying trend continues in Southern California, we may witness (as L.P.Grey hypothesizes) the extinction of _clemencei_ and perhaps _adiaste_ -- hence the entire species -- in our time. By monitoring populations of these two remaining taxa, we may be able to correlate any observed decrease in population size with attendent environmental changes. In addition, we may learn whether competition with other _Speyeria_ species affects _adiaste_. Hopefully, such data (particularly the former) could be exploited as a tool for heading off further extinctions, if that were desired. These data/observations might also enhance our understanding of the disappearance of _atossa_. Naturally, all of what I propose will require a great deal of work. But I am convinced that the rewards would be commensurate with the output, and I am actively seeking help in the continuation of Project Atossa.

Speyeria adiaste and Xerces Society Policies. The Xerces Society in the past has been concerned with beneficial insects which have become extinct or appear to be getting that way, principally due to the effects of human impact upon natural habitat. We, as an organization, have made every effort to save the last remaining haunts of these endangered species. We must now consider the case of _S.adiaste_ and the geographical subspecies which comprise it. This is a species which may well be on a path of protracted extinction -- but as the result, probably, of natural climatic changes instead of human pressure. Should the Xerces Society interfere with natural processes? Where do we draw the line at saving endangered butterflies? Should we install water sprinkler systems in _adiaste_ haunts in order that the larval foodplant, violets, can continue to grow in sufficient density for the insect, while the surrounding countryside continues to become progressively drier? The Society and its members must make a basic decision in the near future, for there will be other "_adiastes_" in North America and elsewhere which we must eventually deal with.

This article is only a brief summary of what was observed and accomplished this year. I am preparing a detailed report, with color slides of habitats investigated, for the Society archives. Hopefully this report will encourage other individuals to undertake similar studies, so that our Society's library

may eventually contain an even greater store of information on extinct, endangered and rare Lepidoptera.

Acknowledgements

I would like to extend my heartfelt thanks to the Xerces Society and the local Sea and Sage Chapter of the National Audubon Society for their financial support of this study. Many lepidopterists, notably Tom and John Emmel, shared their knowledge with me in the course of my research. There is not enough space to mention them all here, but their individual contributions will be gratefully acknowledged in future publications. Most of all, I would like to extend my gratitude to the anonymous donor who, through the Xerces Society, provided me the necessary funds for the field survey.

Speyeria adiaste atossa, ventral. drawing by Larry J. Orsak.

Emmel and Emmel:

"It is a large pale race of the northern California species adiaste, with light creamy buff undersides and pale buff spots in place of the silver spots of the usual fritillary hindwing. . .The male atossa's ground color is a clear, yellow brown."

ABOUT THE AUTHOR: LARRY J. ORSAK
Mr. Orsak is a student in the Center for Pathobiology, University of California, Irvine, CA 92664. In addition to writing the above article, Larry drew the illustrations of Viola and atossa. Shortly after he presented his carefully thought-out proposal for a biogeographic survey to the Directors, funds became available through an anonymous donor, earmarked for research. Larry thus became recipient of Xerces Research Grant #1. Not content with heading up Project Atossa alone, Mr. Orsak involves himself in the Xerces Society base-work for a Red Data list of endangered North American Lepidoptera, and intends activism toward protecting the Catalina Orange Tip and others.

EDITOR'S NOTE ON XERCES SOCIETY POLICIES: In his article, Mr. Orsak raises the interesting question of whether natural extinctions should be prevented. While a firm policy is being worked out, we support the position, so eloquently demonstrated in Great Britain, that all taxa should be conserved and extinctions prevented insofar as that is possible. Extremely artificial management techniques seem a small concession to make if the balance of lost diversity can thereby be redressed even by a single taxon. More later. rmp

SOME EXTINCT AND ENDANGERED LEPIDOPTERA OF TEXAS

Roy O. Kendall

Why protect Lepidoptera?

There are approximately 700 species of RHOPALOCERA (skippers and true butterflies) in the United States fauna north of Mexico. Of these, about 355 are found in Texas. Only one species is known to be carnivorous in the larval stage, *Feniseca tarquinius* (Fabricius), while all the others are herbivorous. Further, only a few species are considered to be detrimental or economically important. Actually, all species in the adult stage are beneficial in their pollenation of plants. This group also serves as a food source for many other animals, including humans in some locales; it furnishes tremendous esthetic pleasure; and provides an ideal set of subjects for scientific study.

To preserve Lepidoptera as an integral part of the total environment, attention must be directed toward preservation of natural habitats and larval foodplants.

How field collecting affects lepidopterous populations.

Although the number of lepidopterists in Texas and the rest of the United States is growing, the writer can see no current damage, nor foresee any threat to local populations through collecting alone. Far more individuals are consumed by other insects and vertebrate predators than are collected by people; a ratio, perhaps, of about 10^5: 1. Furthermore, the writer is of the opinion that most species considered rare by some people are only rare in collections. This is because we know so very little about the distributions and life histories of most species that it is difficult to make an intelligent appraisal.

With the ever-increasing destruction of habitats and larval foodplants resulting from the pressing demands of our rapidly growing population, the time might soon come when certain species are so limited in their range and numbers that it would be advisable to protect them from collecting.

How geophysical factors affect lepidopterous populations.

Climate: Hot, dry, wet and cold individually and collectively tend to limit the spatial distribution of certain species. Occurrence may thus be extended or curtailed for a species over a given range, year or period.

Flooding: Temporary flooding resulting from heavy rains or hurricanes has no significant detrimental effect on populations. In fact, such conditions usually favor the biota. The same is not true for newly created reservoirs which flood permanently large land areas, destroying habitat and foodplants.

Drought: Extreme drought usually reduces butterfly and moth populations temporarily. Some species are able to estivate as immatures during dry spells. Others which do not have this ability may move to another land area, often in great numbers. These vast emigrations of adults extend the species' ranges temporarily.

How Homo sapiens is destroying or endangering non-economic Lepidoptera.

Farming: Total destruction of habitats or larval foodplants results from clearing of land for agricultural use. While non-intensive polyculture (inefficient farming) provides much useful edge habitat, intensive monoculture (efficient farming) does not. Pesticides cause some detrimental effects in nearby uncultivated areas, but in the writer's opinion this is not very significant. Most lepidopterans are not dependent on cultivated plants for survival.

Ranching: Overgrazing, mainly by sheep and goats, has severely altered many habitats in Texas. Burning and the use of herbicides often emloyed in ranching can damage habitats substantially, at least temporarily.

Industrialization: Present-day industry not only produces plant losses to smog in certain areas, but also totally supplants desirable habitats if the industrial utilization is heavy enough. Large amounts of native vegetation are eliminated through highway construction which accompanies industrialization.

Urbanization: Housing developments and shopping centers, schools and offices and other city fixtures seldom accomodate diverse insect habitats.

Outlook.

BASED ON THE CURRENT DEMAND FOR LAND, AND THE RATE AT WHICH NATURAL HABITATS ARE BEING DESTROYED, PERHAPS FORTY PER CENT OF THE NON-ECONOMIC LEPIDOPTERA INDIGENOUS TO TEXAS WILL BE GONE BY THE YEAR 2020.

What can be done to protect desirable Lepidoptera?

Land Use: Set aside and protect as much land as possible NOW for wildlife preserves and management areas.

Basic biological research: Make a concerted effort to determine as much life history data as possible for each lepidopterous species. (The writer has worked out life history studies for about sixty per cent of Texan Rhopalocera.)

Domestic aid: A number of widespread metropolitan species can be perpetuated by propegation of their larval foodplants in city flower gardens.

Hedgerow habitats: A program for the development of hedgerow and other edge habitats along our highways (county, state and federal) should be developed. By propagating certain larval foodplants and nectar sources along roadside verges many invertebrate animals could be encouraged.

Institutional repositories: Collect NOW and preserve in responsible institutional facilities as many examples as possible (or advisable) of each species. In this way posterity will be served with adequate research series. Naturally, this advice applies only to populations which would not be impaired through collecting; which, as stated above, means most if not all in Texas.

SOME EXTINCT AND ENDANGERED TEXAS SPECIES:

Hesperioidea -- Megathymidae (the giant skippers)

Stallingsia maculosus (Freeman) 1955. Double brooded. Scientific interest (as opposed to economic). Non-metropolitan. Type Locality: Kingsville, TX. Distribution: Southern Texas and 35 miles southwest of China, Nuevo Leon, Mexico. Larval foodplant: Manfreda maculosa Hooker. The first colony discovered in Texas was along Parita Creek in Bexar County. This colony has since been destroyed by by developments and farming. The Type Locality is between the railroad and US Highway 77 rights-of-way just south of Kingsville. This area has been completely graded a number of times but the foodplant has always re-established itself. The insect is still present, but in an extremely precarious state.

Megathymus coloradensis kendalli Freeman 1965. Single brooded. Scientific. Non-metropolitan. TL: San Antonio, TX. Distribution: South-central Texas (Erath to Webb County). Larval foodplants: Yucca constricta Buckley, Yucca rupicola Scheele, Yucca pallida McKelvey, Yucca necopina Shinners, and Yucca treculenna Carr. Virtually every colony of this species in the San Antonio area has been extirpated by housing developments.

Hesperiidae (skippers)

Autochton cellus (Boisduval & LeConte) 1834. Multiple brooded. Scientific. Non-metropolitan. TL: America. Distribution: West Texas. Larval foodplant (in Texas): Phaseolus wrightii Gray. This species was common in the Kerville area around the turn of the century. Shortly before this, sheep and goats were introduced for wool and mohair production. The insect has not been found in this region since 1902. Presently it is found only in the Davis and Chisos Mountains where it is rare, especially in the Davis range due to overgrazing. Cellus appears to be fairly well established in Big Bend National Park, but there is considerable competition for its larval foodplant.

Papilionoidea -- Lycaenidae (true butterflies/blues)

Everes comyntas texanus Chermock 1944. EXTINCT. Was multiple brooded, non-metropolitan, scientific in interest. TL: San Antonio, TX. Distribution: Known only from the type locality and outlying areas of San Antonio. Long series were collected in the early 1920's, including the types. Larval foodplant: An undetermined legume. Housing developments have long since replaced texanus.

Nymphalidae (brush-footed butterflies)

Poladryas minuta (Edwards) 1861. Multiple brooded, non-metropolitan, scientific. TL: Comfort, TX. Distribution: Until about 1911 this checkerspot was common over much of the Edwards Plateau and west of the Pecos. Now found in only a few places where its larval host (Penstemon)grows, and where the land is not overgrazed. Recently minuta has been found along the Brazos River near Seymour, and at Lake Kemp on the Wichita River in Baylor County.

REDWOODS AND BUTTERFLIES
Notes on the Political Economy of Preservation

Lloyd C. Irland

> We are the protectors of all living things. All the animals, all the living creatures are our friends and pets. We have this sacred responsibility and obligation because, we, the Hopi people, were the first to set our foot on this continent. No other people have set their foot print before our foot print. We are the first people on this continent and therefore we have this sacred responsibility and obligation . We embrace all within our arms.
>
> --Chief Mina Lansa
> Old Oraibi, Arizona March 1973

Introduction. A large redwood tree weighs approximately $5X10^7$ g; a large butterfly weighs about $5X10^{-1}$ g. This is a weight difference of eight orders of magnitude.

Both redwoods and butterflies are living things in human care and custody. For a hundred years, people have been working to preserve redwoods. They are easy to see, make spectacular tourist attractions and are deeply missed once gone. They are awesome in size, beauty and age. Their removal scars the land and may injure wildlife and watersheds.

But it is only recently that people have become concerned about creatures weighing 10^8 less than redwoods -- the insects. Perhaps someday our concern will reach a few orders of magnitude smaller, to the bacteria, algae and fungi which inhabit the earth's soil, waters, atmosphere and living things. These creatures endow us with oxygen itself and can provide valuable antibiotics, chemicals and even foodstuffs.

In this paper I will examine reasons why it is desirable to preserve environments and living things, and policy problems of nature preservation. I will then describe how preservation has come to be a political issue. Finally, I will offer some views on the role professional scientists can play in the politics of preservation.

Why preserve natural environments and living things?

There are reasons both practical and ethical for taking care to preserve natural environments and threatened species. Practical reasons include our uncertainty as to the effects of altering nature's balance, the direct recreational value of wild areas and the assurance that values placed on such wild areas are certain to rise.

Natural areas are valuable to people for recreation. For just scenery-watching, hiking, camping or boating, people want natural surroundings. And they are willing to pay for it. Evidence is seen in taxes on sportsmen's gear being used for land purchases, in private groups buying land for open space and in voters taxing themselves to finance public land acquisition.

Technological change expands the supply of natural resource-based raw materials. It permits us to cut the input of coal per kilowatt of electricity generated. It permits us to mine lower-grade ores than ever dreamed possible. It helps us discover reserves of minerals impossible to locate with older methods. Cumulatively, technology makes raw materials cheaper. The current inflation in world primary product markets in no way alters this conclusion. However, technological change and economic growth also reduce the area occupied by natural communities. Natural environments can be recreated only at such expense or over such long periods as to be essentially norenewable once destroyed. An extinct animal or plant species, of course, cannot be recreated at all.

But growth inpopulation and income tends to raise the value people place on preserving natural areas for recreational, esthetic and ethical reasons. So growth tends to reduce the price of raw materials while simultaneously raising the value placed on amenity services provided by nature. These facts provide a powerful economic argument for preservation of nature.

When social and economic costs and benefits are fully examined, it often happens that society's wisest course is to leave nature undisturbed. This frequently is the case with steep sensitive watershed slopes, with floodplains, with aquifer recharge areas and with coastal slat marshes. When the advantages gained from development of such areas are fairly balanced with the disadvantages. preservation often makes good economic sense.

In addition, urban and suburban open space and greenbelts have important market values. Many studies show that real estate prices are strongly influenced by proximity to parks or attractive views. Premium prices paid for seashore and lakefront property demonstrate this. Under our existing tax system, open space may have another financial value. This is because residential or commercial development may yield insufficient tax revenue to cover the public service costs created. For this reason, some communities have actually gone into debt through bond sales to buy land and prevent its development.

We know very little about the ultimate effects on human welfare of wetlans destruction or permitting species to become extinct. Because we are often uncertain of the ultimate effects of our actions, caution is in order. This argument, then, calls for preservation as a means of reducing risks that may be created by development.

Finally, people have cultural and historical attachments to many natural areas and animal species. Preservation of the Gettysburg battlefield, of Abraham Lincoln's home or of the buffalo all spring from this source. In a nation born on a frontier and shaped in subduing a continent, the untouched outdoors holds a special importance not felt as strongly perhaps in older, more densely populated nations.

In the case of endangered plants and animals, ethical considerations are often paramount. Not being a philosopher, I will be brief here. I find several distinct ethical concepts useful: a) Human duty as trustees or guardians of the earth on behalf of its defenseless creatures; b) human duty as trustees of the earth to provide a legacy to descendents and a heritage from ancestors; c) respect for life itself; d) the equality of all creatures in their claims to a place on earth; e) religious concepts. Different blends of these rationales form the guiding manifestos for most branches of the nature conservation movement, in concert with the practical bases hitherto mentioned.

Thus, the case for preserving natural environments and living creatures stands on a firm pragmatic and philosophic foundation. However, there appears to be a strong case for growth as well. At least, growth in population will be a reality in the United States for at least sixty years and worldwide for a good deal longer. I firmly believe that with sound planning and land use policies we can accomodate the growth we anticipate without destroying the environment or our quality of life. I am, however, not optimistic that the required sort of planning will soon be forthcoming.

<u>Preservation policies</u>. Policies to preserve endangered species must successfully deal with a wide range of threats to species survival. One of the most important causes of extinction is habitat destruction. The most effective response to such a threat is habitat protection through public ownership. State and local land use controls may serve the same end.

The Wilderness Act of 1964 illustrates the obstacles encountered in preserving natural areas. The Act only emerged after eight years of congressional hearing and compromises. In the process, important preservation opportunities were missed. Funding was not provided for agency wilderness studies. Mandatory review of National Forest roadless areas and Bureau of Land Management holdings was mandated prior to 1984. In all, the Wilderness Act represented a grudging concession by special interests, and not the strongest possible program for conservation. Since passage of the act, conflicts over criteria for adding areas to the federal wilderness system have been incessant. And once Wilderness Areas are created, knotty problems of administration arise. How can the land be protected from overuse by hikers, campers and packstock? Should fires be controlled or allowed to burn? Wilderness preservation brings problems with its blessings.

Pollution may seriously threaten some species. A well known example is the effect of DDT on Osprey reproduction. Another is the unmeasured influence of fertilizers and pesticides on the microbiota of soils and waters. Policies for pollution control see at least nominal implementation in most advanced nations today. Rapid progress in pollution control will materially aid insects.

Direct destruction of individuals may in rare cases threaten species survival. Egrets, alligators and Sea Otters have come close to losing out respectively for their plumage, hide and pelage. Exploitation for various products threatens whales severely. The American Bison was drastically reduced in numbers at least partly for military reasons. While Coastal Redwoods sustain huge losses for their valuable wood, the species itself is less threatened than the largest stands of the most ancient individuals. Collecting has been cited in several cases as contributing to the decline of rare species, although this may be more readily imagined for stationery wildflowers than for insects. Policies to regulate direct killing include bans on trade in products made from endangered species, control of hunting and harvesting by law or treaty and economic boycott. Enforcement of such policies can be very difficult.

While nationally prominent issues receive most of the publicity, preservation is operating at all levels of government. The Trans-Alaska pipelines, the Mineral King dispute and the "zero discharge" goals set forth in the 1972 Water Pollution Control Act amendments illustrate federal decisions in various branches which have had major impact on environmental quality. Much public and professional attention is devoted to such issues. But many wildlife conservation issues are regional in nature, such as the American Alligator; and others are intensely local, including the Red Wolf, the Desert Pupfish and the Schaus Swallowtail. Such locally oriented issues can be approached with the special flexibility offered by smaller governments. Many states, for example, operate extensive systems of wildlife refuges, forests and parks. More recently, state scenic river and wilderness systems have been established. Private groups such as the National Audubon Society and The Nature Conservancy make important contributions to the local and regional and sometimes national scenes. Combined action by federal, state, local and private bodies will be required more and more to meet future preservation challenges. Beyond, on an international level, quasi-governmental groups such as the conservation and research programs of UNESCO and FAO link with private efforts of the World Wildlife Fund, IUCN and other bodies. From city council to the UN, the preservation spectrum is broad.

Politics of preservation. Preservation as a political issue has been with us for many years, ever since the fights to save Yellowstone, Yosemite and Hetch-Hetchy. But in the late 1960's, the movement broadened its scope of concerns and attracted a broad base of popular support; in consequence, it acquired a certain political respectability. Preservation is unavoidably political for two reasons. First, it involves value judgement. What is worth saving? At what cost? For what reasons? Second, decisions to preserve or develop natural resources affect different interests differently. A decision to permit mining in Idaho's White Cloud Mountains would benefit miners, mining companies and perhaps the users of molybdenum. But that development might also injure fish and other wildlife populations and would reduce hikers' enjoyment of the area. Decisions about the White Clouds thus require discrimination among interests, as to whose will be considered more important. The answer, rarely obvious or objective, cannot in any event be determined wholly through scientific or technical means.

The market is our society's favored method of decision-making. And, critics notwithstanding, it can do most jobs quite well. The market, through anonymous interactions between buyers and sellers, determines what will be produced and who may consume it. In the best circumstances, a free market can be an admirably efficient decentralized communicating and computing machine. Very often, poor market functioning is due to ill-advised or inept government meddling, rather than to fundamental defects in the system itself.

But there are many areas of life in which markets function poorly. We do not entrust our schools and hospitals to purely profit-motivated enterprise. We are not, of course, always satisfied with the services rendered by nonprofit institutions either. But for some needs, they seem to work best.

Nature preservation is a prime example of a service poorly suited to private production in a market. First of all, the preservation of a scenic canyon may yield satisfaction to many individuals who never visit it. The market only registers preferences of those who walk through an admission gate and pay. The distant non-visitor cannot register his or her concern. In the same way, the market cannot count the preferences of future consumers. These are political problems, soluble only by political means, through government.

The purpose of government is to provide services which cannot be provided by individuals, private groups or firms. Such services include national defense, police protection and the provision of legal order and enforcement of private contract. Government, in its legislative function, must also settle conflicts among citizens by deciding whose views and needs shall be favored. In America, the cause of preservation has been abused by government as often as it has been favored or advanced. Why is this?

One reason is the tendency for bureaucracy and legislatures to become attached to favorite programs which proceed without regard for need. Programs such as land "reclamation" and interstate highways become sacred. Legislative pork-barrelling and bureaucratic imperialism both contribute to this. Most important, however, is the fact that our political system provides for preservation values scarcely any support. The reasons are not vague. Subsidy of flood control, highways, canals and wool growing, supported by strong lobbying for which the beneficiaries can afford to pay, impair wildlife immensely. Regulations often threaten industries with severe financial burdens, causing the firms to redouble efforts to lobby intensively against tougher air and water standards or land use controls.

In contrast, support for preservation is diffuse and depauperate. Interests opposing unwise developments lack the money and power of opponents. For these reasons, citizens have often had to sue their own government to protect natural values that were ignored in public decision-making. The rising environmental concern of the 1960's was prompted by recognition that government, not private enterprise, was emerging as a major destroyer of amenity. The inability of either market or government to protect ecological values created a major protest movement. The movement stems from at least as long ago as the 1890's, when the Audubon Society formed to fight feather use in millinery. The movement thus born, and which matured in the last decade, has these major features:

First, new organizations have come together and older groups have broadened their interests and activities. The Sierra Club is in Court over air pollution. New public-interest law firms oppose the Atomic Energy Commission's fast breeder reactor program. The Xerces Society speaks for butterflies. Popular support for these organizations has been impressive.

Second, changing legal doctrines and new legislation have permitted greater citizen access to the decision-making process. The National Environmental Policy Act has already had a major impact on federal policies. Agencies are considering alternatives to traditional methods, are examining the environmental consequences of their actions, and are making this information public. Such improvements as have been made are largely due to vigorous legal action by concerned groups of citizens.

A third significant new feature is the high involvement of the media in the new protest over ecological insults. Newspapers, TV and magazines have brought water and air pollution and clearcutting into Middle America's living room. Although the calibre of reporting is often low, a new public awareness is being spawned.

Finally, the public involvement of scientists, academics and other experts is increasing. Scientists address senate committees, speak at public hearings and meetings, hold conferences for the community and publish books and articles for the general reader.

<u>The role of professionals</u>. How can the professional scientist contribute to today's preservation debate? Economists argue that specialization encourages efficiency. If so, then entomologists can make a major contribution to preserving insect populations simply by doing more and better entomology of kinds other than strictly economic emphasis. Field and applied management studies are needed for political application. If an administrator is to deny a building permit or oil lease on biological grounds, he or she must have solid, place-specific data on which to base decisions. Without these data, any good judge will set the action aside as arbitrary and capricious. Good theories and speculations help little; reliable field information, a great deal.

People understand redwoods, I suspect, better than they understand butterflies. If insect species are to be considered worth preserving, it can only be with public support. This means that professionals and serious

amateurs must carry their message and their expertise to the public, to politicians, to bureaucrats. Our world of science and academia gives brownie points for specialized (sometimes unintelligible) monographs, but not for non-technical communications to the lay reader. We cannot change this reward system, perhaps; but we can take time to explain our field to interested outsiders. If we do not, we cannot criticize citizen studies which are short on facts and long on allegation. The facts must come from professionals and other specialists.

Finally, authorities can take public roles as advocates. They can serve as consultants or expert witnesses, can speak and write to influence opinion and can indulge in arm-twisting with legislators and officials. Experience shows, however, that skills other than scientific are most useful in these pursuits. And even the best of scientists have fallen into the trap of bending their science to suit the research needs of the program or policy they advocate.

Conclusions. The human need to conserve living creatures is solidly based on economic necessity and on persuasive ethical arguments. Redwoods and butterflies depend on human stewardship for their survival. We cannot be certain that our own survival does not rest on the responsible exercize of this stewardship. But we can very clearly see that each extinction diminishes our world.

Political conflict over nature preservation will not diminish in the future. The failures of markets and governments in nature stewardship will not be remedied overnight. I believe that responsible participation in this process by scientists, professionals and other citizens with something to say will help to make the world safe for redwoods and butterflies.

Dr. Lloyd C. Irland teaches courses in the politics of preservation and water resources at the Yale School of Forestry and Environmental Studies, where he is Assistant Professor of Forest Economics. A young and popular teacher-researcher-activist, Lloyd presented the foregoing paper at the First Annual Meeting of the Xerces Society last April at Yale. It was well received.

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MANTID PREDATION OF LEPIDOPTERA

Terry Lawrence Chester

Those people fortunate enough to care for a bit of land may wish to create a butterfly garden, as well as a worthwhile vegetable garden. The paradox: many people are concerned about arthropod predators in their butterfly gardens, but wish to utilize these natural predators to control garden pests without chemical interference.

Praying mantids, which are more beneficial than harmful, have been used extensively as control agents for insect pests in vegetable and horticultural gardens. Oothecae, the egg cases of mantids, are placed in these plots to ensure a strong mantid population. However, of the hundreds of tiny mantids that hatch, few survive to the adult stage. Those which do mature may move into the butterfly garden and cause mortality among the lepidopteran population. If so, is this mortality considerable?

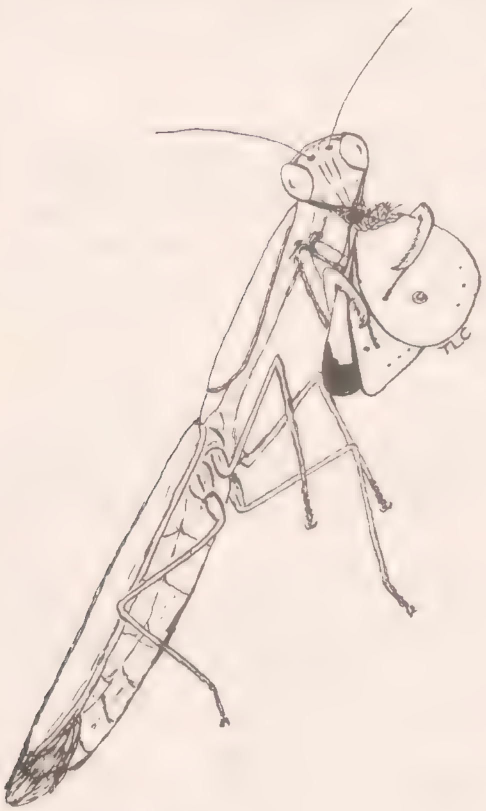
Mantids patiently await their prey in a prayer-like posture. This attitude belies their incredibly voracious appetites. Indeed, mantids strike at any moving object of suitable size. On one occasion, I tried feeding a Red-backed Salamander (*Plethodon cinereus cinereus*) to a European Mantid (*Mantis religiosa*). The amphibian was quickly grasped and partly devoured!

During the course of a day, several butterflies and moths probably fall victim to a given mantid. While field observations reveal these cryptic creatures to be rather indiscriminate in their selection of food, laboratory studies prove that mantids have the ability to learn and to discriminate distasteful prey. Danaids and Acraeids, when captured, may prove too unsavory for mantids to finish a meal of them. Some of the Danaidae that have been rejected include *Parantica eryx*, *Trepsichrois mulciber* and *Tronga crameri*. The warningly colored black-and-white day-flying moths of the genus *Deilemera* (=*Nyctemera*) also elicited refusal (Shelford, 1903). However, other aposematic Lepidoptera, namely *Mylothris*, *Neptis*, *Alaena*, *Pentila* and *Egybolis*, were eaten by mantids. *Pardopsis* was observed to be more distasteful than the general run of *Acraeas* (Marshall and Poulton, 1902). You could contribute to our understanding of this

phenomenon by watching to see if your garden mantid seizes and consumes the splendid Monarch, which is of course distasteful and warningly colored.

If these acrid butterflies and moths are often rejected by praying mantids, others appear to be relished. There is substantial evidence for this. In India, for example, Williams (1904) observed that the "favorite" food of an adult mantid seemed to be a skipper closely allied to the British Dingy Skipper (Erynnis tages). In Hawaii, Spodoptera mauritia, Pieris rapae and Lycaena boetica were fed upon by a Chinese Mantid (Paratenodera sinensis) (Hadden, 1927). Bromley (1932) witnessed a Chinese Mantid eating Cabbage Butterflies, a small fritillary and a Viceroy; while Didlake in 1926 discovered mantids preying upon the hairy caterpillars of Datana and Apatela. In an alimentary tract analysis, sixty per cent of the mantids examined had ingested Lepidoptera (Thierolf, 1928). So the butterfly gardener's reluctance to invite mantids into the garden is understandable. But are there really any grounds for alarm?

Since mantids lie in wait for their prey, they are more likely to capture resting butterflies and moths and their crawling larvae than adults in flight. For this reason and because of their small total numbers and indiscriminate feeding behavior (which assures a huge a varied menu), praying mantids in your vegetable plot appear to present no particular threat to the lepidopteran fauna of your butterfly garden.



Besides, mantids themselves offer hours of refreshing and intriguing observation.

Why not use your butterfly garden as a stage, where you can watch the fascinating interactions between predator and prey? It is doubtful that you would sacrifice very many butterflies and moths in this fashion. Yet the rewards, in terms of both increased interest and decrease of competitors for your vegetables, could be great.

A butterfly reserve of any size, especially if it has mantids in residence, will give you a unique outdoor experience of ecology in action.

Terry Lawrence Chester, who wrote & illustrated this unusual article, pursues studies in wildlife ecology and entomology in the Yale School of Forestry and Environmental Studies. A native of Jersey City, Terry hopes to travel widely in the tropics and to monograph the Mantodea.

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ON THE WING

CURRENT ISSUES IN LEP. CONSERVATION

West Rock: Two down, one to go. Xerces members who attended the First Annual meeting in New Haven last year will recall West Rock Ridge, west of the city. On this trap-rock ridge live probably more species of butterflies (resident and regular immigrant) than at any other Connecticut locale -- including the lovely Falcate Orange Tip (Anthocharis midea) which we saw on our field trip. A bill passed to protect the rock and its wildlife in a new state park passed, only to be foiled by a city/state jurisdictional dispute. With the hassles now ironed out, a new bill will go to the General Assembly. This is the third try.

And farther west: A good news story from Colorado. For many years the Director has been involved with conservation of habitat along the Highline Canal, which runs from the South Platte Canyon eastward through Denver and suburbs and on to the plains. Among the 75 or so butterflies recorded for the canal is the Painted Crescent (Phyciodes picta), known previously in Colorado only from the far away Arkansas River Basin. A tiny, tenuous meadow among subdivisions has been a XS concern, as it is the chief picta habitat. While negotiations with the city and the developer have gone slowly, the butterfly has been helping itself: a visit last summer showed that its range has increased along the canal for a full mile! If politics fail, the refugium of the Highline Canal Trail may save the day.

The Karner Blue, still... We were all delighted to read in the last Wings of the 160-acre reserve set aside in the Albany Pine Bush, which XS and the KB helped with. But Robert Dirig informs us that the reserve is in less than prime habitat and that much more land can and should be reserved NOW. Please continue support.

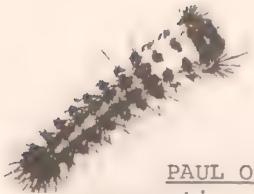
Big Soos Coming Our Way. The Big Soos Butterfly Reserve, alias the Harold and Anne Johnston farm in Kent, WA, will yet become our first reserve, despite delays. Tax problems required the sale of one acre of the fourteen, and additional legal quagmires hold up acquisition. But The Nature Conservancy Northwest Office (through Ken Margolis) will soon take title and transfer will follow. Society plans to establish an insect awareness center for the Seattle region stand firm.

Atala fortunes improve. Eumaeus atala florida, the brilliant green hairstreak for which this journal is named (see cover, Vol. 1 # 2) has been considered to be extremely scarce if not extinct in southern Florida. Recently, Theclini authority and Lepidopterists' Society President Harry Clench has reported 'new' populations of atala in the Caribbean which seem clearly to be florida.

US Forest Service cares. In a decentralized agency such as the USFS, much can be accomplished on the local level by concerned citizens working with officials. Hence our successes with Oregon Silverspots on the Siuslaw National Forest. Recently, Mr. W.L. Lloyd (Supervisor of the Cibolla NF, NM) has affirmed that the new Land Use Plan for the Sandia Mountains will definitely contain management priorities and objectives for conserving the Sandia Hairstreak (Callophrys (Sandia) macfarlandi) and its foodplant. Although not restricted to its namesake range, the recently discovered green butterfly haunts a limited number of places.

California round-up: South. In addition to S.a.atossa (reported on in this issue) the S. Cal. extinction syndrome has claimed and threatened several insects. One of the rarest now is the El Segundo Blue, a form of Philotes battoides. This distinct and diminuitive blue occupies only a couple of shabby duneland sites near Santa Monica. As XS enters talks with Standard Oil over one of these patches, the situation will be overseen by members Jeannine Oppewall, John Lane and John Emmel. Meanwhile, Fred Thorne writes of some undeveloped public lands near San Diego which, in their current state, support excellent stands of rare plants and associated butterflies well worth conserving: we're pursuing this.

And North. As this goes to press, Antioch (CA) City Council is studying input for a General Plan. They have been gently bombarded with testimony about Lang's Metalmark, Apodemia mormo langei, which occurs NOWHERE ELSE but on leftover scraps of duneland in Antioch. Paul Opler, Chief Counsellor Jerry Powell and both Directors have spoken up so that langei will not go the way of G. xerces.



METAMORPHOSES

XERCES PEOPLE IN THE NEWS

PAUL OPLER. In a highly significant act of federal recognition of Lep. conservation, XS member Dr. Paul Opler was appointed this fall to the USDI as official government insect conservator. Working out of the Office of Endangered Species, Fish and Wildlife Service, Washington, DC 20240, Paul holds the post of Staff Specialist in Entomology. A long-time ally and activist in Xerces, Dr. Opler comes to his important new job from the Organization for Tropical Studies in Costa Rica. There and at UC-Berkeley he carried out research in insect ecology, winning his PhD for his well known work on marble wings (Euchloe). Dr. Opler has maintained frequent contact with the Directors since his arrival in DC, and it is a tremendous relief to know that such a capable individual now represents insect conservation on an official level and with substantial power. In a recent phone conversation, the editor learned Dr. Opler's chief priorities: determination and designation of threatened and endangered US species and ssp; and documentation and prevention of further losses in such extinction hot-spots as the California dunes systems and southern Florida. We anticipate an extremely close working arrangement with no duplication or competition, building instead a true synergism. We will be telling much more about Paul in the interview to appear in the next issue. Our heartiest and happiest congratulations go to Paul and to the officials who saw fit to actualize this pioneering step.

ROGER PASQUIER. The Xerces Society proudly announces that the long, anxious search for a Treasurer has ended with the appointment of Roger Pasquier to the position. Mr. Pasquier was suggested by XS member ALAN POOLE and approached by Assoc. Dir. JO BREWER. Following his gracious assent, the appointment was ratified by the Chief Counsellors on November 1. Mr. Pasquier received his BA in art history from Columbia in 1969 and proceeded with graduate work in the same field at UC-Berkeley. His present position with the Wave Hill Center for Environmental Studies (Bronx) as Special Projects Co-ordinator involves arranging and directing programs in adult education. Roger first became butterfly-oriented at age six, with birds soon overtaking butterflies as his major interest (as official keeper of the Central Park Bird List, a stewardship handed down from such luminaries as Ludlow Griscom, Roger was featured recently in The New Yorker. A Manhattan resident, he has served on the Council of the Linnaean Society of New York. Four years ago his interest in butterflies revived, but as a watcher rather than as a collector since he finds NYC butterfly populations less than prolific. Now, as XS Treasurer, Roger will receive your membership renewals (with new memberships still going to Jo Brewer). Now staffed with a qualified Treasurer, your Society will redouble its efforts to obtain tax-exempt status and incorporation. Our thanks go to Jo Brewer for her interim efforts on behalf of the books, with the able aid of GEORGE BREWER. And thanks to Roger!

JACK DEMPSTER. Dr. Dempster, whose superb autecological research on the Cinnabar Moth and the British Swallowtail have provided a major cornerstone for scientific insect conservation, has recently been appointed Director of Monks Wood Experimental Station, Institute of Terrestrial Ecology, Abbots Ripton, Huntingdonshire, England. Jack succeeds Professor KENNETH MELLANBY in this post, and we certainly hope he will continue his research as well. Our warm congratulations go to Jack and to Her Majesty's Government for their wise choice.

ROY O. KENDALL. Long-time Texas Lepidopterist Roy Kendall, well known to and liked by many of us, received a request from Baylor University's Inst. of Environmental Studies to deal with leps for their Rare and Endangered Species Conference. Roy's study, which appears in this issue, will go to the TX state Legislature. Certainly no more qualified person could have been found for this.

BERNARD HEINEMAN. On May 24, XS member Barney Heineman received an honorary degree from St. Lawrence University. An avid NYC amateur lepidopterist, Mr. Heineman collaborated with XS C.C. F.M. BROWN on Jamaica & Its Butterflies.

EDWIN WAY TEALE. The Pulitzer Prize-winning XS H.C.'s new book, A Naturalist Buys an Old Farm, was published by Dodd, Mead this autumn. The editor wholly recommends this book, following a delightful visit to its subject, Trail Wood. Mr. Teale writes about his famous insect garden and very much more.

ALAN BROOKS of the Natural Resource Ecology Laboratory, CO.St.U., will be conducting grassland Lepidoptera conservation research for XS. Along similar biotic lines, KURT JOHNSON (O.H.C.)has submitted a major paper on plains ecology with respect to changes in butterfly populations, for XS publication.

ED GAGE, WA lepidopterist returned from graduate studies in Arkansas, will be writing an at-large column for Atala. One topic will be monoculture.

MEMORIA

SIDNEY HESSEL

Connecticut lepidopterists were deeply bereaved recently to learn of the death of Sidney Hessel. As the news spreads the sadness will follow, so well was this modest man known among butterfly and moth people across the world. An early and especially helpful member of the Xerces Society, Sid brought his humble knowledge and warm presence to our first meeting. It is appropriate that we note here, from information supplied by Mr. Hessel's dear friend Charles Remington, something of the man's rich and varied life.

Born in New York City in 19[illegible], Sid took his AB at Harvard in 1928 and an MBA at the Harvard Business School in 1930. He saw to the practical side of his life with business concerns in New York, while spending as much time as he could in the field. First in Woodmere, Long Island, and later for two decades at his Washington, CT residence, Sid studied Lepidoptera right in his carefully selected back yards. The devoted countryman's field work extended, however, to Africa upon repeated fruitful expeditions; and to the spruce bogs, meadows and forests of Lakehurst, NJ. That he found tremendous satisfaction in the nearness of Jersey as well as in the adventure of Africa was typical of Sid's observant, resourceful nature. In fact, it was at the Lakehurst locale which he so loved that Sid, along with Xerces Society Chief Counsellor George Rawson, discovered the lovely green butterfly which was to bear his name forever as Mitoura hesseli. One of the editor's fondest recollections of Yale will be the tale of that discovery, extracted from Sid only after persistent request, then told with relish.

As a Research Associate in the Yale Peabody Museum for some twenty years, Sid served as de facto curator of North American moths, African butterflies and world [illegible]. This broad expertise suggests a versatility confirmed in the additional roles of world authority he filled with regard to Catocala moths and philatelic Lepidoptera. His major publications include papers on the natural history of Mitoura hesseli and [illegible] and on the larval biology of Pap-ilio. Yet beyond these scientific accomplishments Sid still found time to help the many other enthusiasts. As an early Treasurer, he brought fiscal order to the Lepidopterists' Society, years ago. Later he conducted a survey of rare and endangered moths for that group, which the Xerces Society hopes to publish.

In addition to his science and his friendships, Sid Hessel will leave several enduring and magnificent monuments to his work. His great and definitive collections have contributed to many another, and the bulk will reside at Harvard in the Museum of Comparative Zoology as a perpetual resource. Sid's longtime efforts toward a treatment of the Lepidoptera of Connecticut will see posthumous expression in a bulletin of the CT Geological and Natural History Survey. And perhaps most impressive, and most telling of his vast generosity, Sid endowed a professorship and curatorship at Harvard to be known as the Hessel Chair of Lepidoptera. Our sympathy is with Mrs. Bea Hessel, who remains with us as a warm friend. Sid will be missed by us all, but remembered.

rmp

LESLIE HUTCHINSON

Fine naturalists seem to live in friendly places. As Sid lived in Nettleton Hollow, the abode of Leslie Hutchinson was Owl Cottage, Mottestone, Isle of Wight. Leslie Hutchinson was born in 1904 and died this autumn after a country life. Early in his colorful English existence, Leslie, as President of the Cambridge University Union, debated with the present Archbishop of Canterbury and bicycled throughout the shire. Later he followed the life of a distinguished educator, not surprising in the son of a Master of Pembroke College, Cambridge, and the brother of the renowned Yale ecologist Dr. G. Evelyn Hutchinson. A progressive educational reformer, Leslie culminated his career as County Education Officer of the Isle of Wight from 1941-1969.

Leslie's tie with the Xerces Society grew from his involvement in the conservation efforts on behalf of the Glanville Fritillary (Melitaea cinxia). In Great Britain this checkerspot lives only in a few coastal sites on the Isle of Wight. As President of the IoW Natural History and Archaeological Society, Leslie spearheaded the continuing movement to protect habitat of the Glanville Fritillary and to study the insect's natural history and management needs. In 19[illegible] he wrote [illegible], a history of the Society and its findings. The book's cover, as did the Society's emblem, borrowed its motif from

toughly, prowling and searching for a sign of cinxia. One of England's rarest

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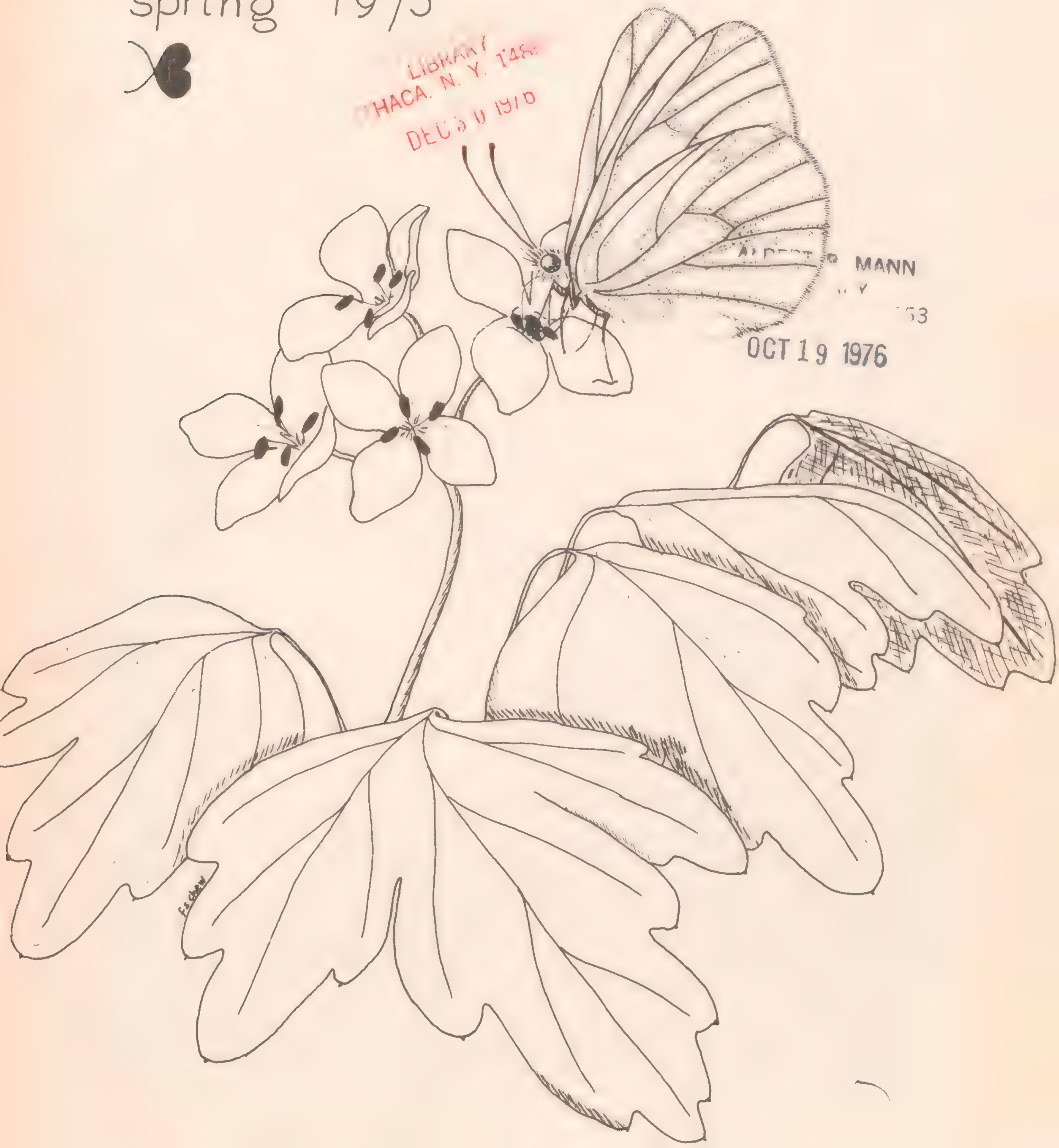
Metamorphoses: Xerces People in the News

A Colorado Canal and its Butterflies

to make a world full of flowers."

atala

volume 3 number 1
spring 1975



COVER CREATURF

Pieris virginiensis Edwards, the West Virginia White

drawn by Francie Sze-Ling Chew

Although recognized in the nineteenth century by Edwards, Pieris virginiensis has only recently been clearly distinguished from other members of the Pieris napi/oleracea complex. Certainly the West Virginia White is distinctive ecologically, flying in deciduous woodlands. The rather similar Mustard White, in contrast, occupies forest edges, clearings and other open places. P. virginiensis has adapted to the forest, which few butterflies haunt, by using Toothwort (Dentaria) as its larval host, rather than some sun-loving crucifer. The butterfly's woodland proclivity has its advantages and disadvantages for the survival of the species. On the plus side, P. virginiensis does not have to cope with interspecific competition from the introduced P. rapae, the common Cabbage Butterfly, which eschews the forest. P. napi, on the other hand, probably must compete with P. rapae in at least some of the habitats it occupies; and where the alien is better adapted, the Mustard White loses out. On the minus side, however, the West Virginia White is directly liable to human operations in the forest. Nearly twenty-five years ago, Alexander Klots expressed concern in his Field Guide to the Butterflies that P. virginiensis may have been reduced in numbers by destruction of the woodlands. Alarm has echoed through many articles and papers, most recently in a note by R.R. Tasker in the current number of the Journal of the Lepidopterists' Society (29: 23), where the very local insect is noted to be "especially vulnerable to urban development and cutting for firewood." Restricted to relatively few locales in the Transition Zone from Virginia north through central New England and New York to Ontario, this pale and pretty butterfly is one of the special rarities on West Rock Ridge, New Haven, Connecticut. Here the Xerces Society has been involved in the movement to preserve the Ridge in a new state park. Elsewhere, lepidopterists representing the Xerces Society and other groups have succeeded in acquiring protection for one of the northernmost populations of the West Virginia White, as Quimby F. Hess tells on page six of this issue.

THE

XERCES SOCIETY

An international, public & non-profit organization for the conservation of rare and endangered populations of butterflies, moths and other terrestrial arthropods.

* *

Membership in the Xerces Society is open to everyone who shares our concerns. Members receive the journal Atala twice yearly and the newsletter Wings three times yearly. New members should send dues, which are $5.00 per year ($2.50 for students) to the Associate Director, Jo Brewer, 300 Islington Road, Auburndale, MA 02166. Renewal dues go to the Treasurer, Roger Pasquier, 235 E. 73rd St., New York, NY 10021. An informational brochure is available upon request from Jo Brewer. If you have any substantive knowledge about an insect conservation problem, please write the Director, Robert Michael Pyle, Yale School of Forestry and Environmental Studies, New Haven, CT 06511.

* *

INFORMATION FOR CONTRIBUTORS TO ATALA: Manuscripts are solicited which deal with the politics and ecology of insect conservation. Information should be sound and speculation minimized. Since we are a natural history publication for people of many backgrounds, most of whom have some sophistication with Lepidoptera, please write carefully but colorfully as well. We need butterfly and other conservation news items for On the Wing and personality notes for Metamorphoses. Non-Lepidoptera material is particularly desired for Out of Order. Publication will normally be within six months of acceptance. Manuscripts should be typed, double-spaced, in conformance to a major style manual and with full references to literature cited. Include drawings or black-and-white photographs, if possible. Separate illustrations of high quality will also be considered for publication in Atala. Contributors will receive several free copies and our special thanks.

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ATALA, the journal of the Xerces Society. Published at New Haven, CT., USA.
Volume 3, Number 1......publication date 20 May, 1975
Editor: Robert Michael Pyle, Yale School of Forestry & Environmental Studies, New Haven, CT. 06511. Our thanks to C.L. Remington, for the use of the electric typewriter with which this and the last issue were produced; and to Janet & Peggy at Dwight Hall Press, for their care.

ENDANGERED SPECIES

CLEARLY, the most crucial early step to be taken in wildlife conservation is the identification of threatened and endangered species. Until we know which organisms stand to be critically compromised by habitat changes, we cannot prescribe optimal habitat conservation measures. Perhaps more important than the endangered species themselves are the communities they represent. In efforts to arrive at intelligent assessments of the situation, Dr. Paul Opler of the USDI Office of Endangered Species and Larry Orsak of the Xerces Society have been gathering data on possibly endangered taxa of North American butterflies. Atala is pleased to present here the results of both surveys, in the hope that readers will communicate with Dr. Opler and Mr. Orsak any information they may have concerning the butterflies listed. It is stressed that these names are under consideration only -- nothing has yet been placed on the Federal Endangered Species List; and that since the majority of these animals are considered "threatened" rather than truly endangered at this time, officially listing them will not preclude collecting them for study. Habitat conservation is the key issue, and the reason behind the listing is to save habitat.

OPLER

(The following list is from a NOTICE OF REVIEW published in the Federal Register on March 20, 1975. Comment should be submitted prior to June 18, 1975 to: Director, Fish and Wildlife Service, U.S. Dept. of the Interior, Washington, D.C. 20240, att: Dr. Paul Opler, OES.)

(name and states where found)

Parnassius clodius strohbeeni	CA
Anthocaris cethura catalina	CA
Euchloe hyantis andrewsi	CA
Eurema dina dina	FL, Cuba
Euptychia mitchellii	IN,NJ,MI
Cercyonis meadi alamosa	CO
Oeneis chryxus valerata	WA
Speyeria nokomis nokomis	UT (+CO)
S. n. apacheana	CA,NE
S. n. nitocris	AZ
S. n. caerulescens	AZ,NM,Mexico
S. zerene myrtleae	CA
S. z. hippolyta	OR
S. adiaste adiaste	CA
S. a. clemencei	CA
S. a. atossa	CA
S. egleis tehachapina	CA
Euphydryas editha wrighti	CA
E. e. monoensis	CA
Poladryas minuta	TX
Limenitis archippus obsoletus	AZ,CA,NE
Eumaeus atala florida	FL,(Bahamas)
Callophrys mossi bayensis	CA
C. m. doudoroffi	CA
C. m. windi	CA
C. lanoraieensis	ME,Canada
C. hesseli	DE,MR,NJ,NY,NC,VI
Vaga blackburni	HA
Lycaena arota nubila	CA
Lycaeides melissa samuelis	NY,(WI),Canada
L. argyrognomon lotis	CA
Icaricia icarioides missionensis	CA
I. i. pheres	CA
I. i. moroensis	CA
Philotes enoptes smithi	CA
P. battoides (El Segundo population)	CA
Apodemia mormo langei	CA
Stallingsia maculosus	TX
Megathymus coloradensis kendalli	TX
Hesperia dakotae	IO,MN,SD,Canada
Problema bulenta	GA,NC,SC,VI
Panoquina panoquinoides errans	CA,Mexico

(In addition, the following two species were listed in a PROPOSED RULE-MAKING by OES as published in the Federal Register on April 22, 1975; comment solicited until July 21, 1975.)

Proposed for THREATENED STATUS:

Papilio aristodemus ponceanus	FL
P. andraemon bonhotei	FL

ORSAK

(This list was submitted to the Xerces Society on March 31, 1975. Responses of any kind, espially those concerning status of populations, will be welcomed by: Larry Orsak, Center for Pathobiology, University of California, Irvine, CA 92664.

EXTINCT AND "LOST" BUTTERFLIES

Euphydryas editha insularis	CA
Phyciodes tharos pulchella	CA
Speyeria adiaste atossa	CA
Cercyonis behrii behrii	CA
C. sthenele sthenele	CA
Eumaeus atala florida	FL
Everes comyntas texanus	TX
Glaucopsyche piasus sagittigera	CA
G. xerces	CA
Philotes battoides (Tehachapi pop.)	CA
Plebejus icarioides pheres	CA

ENDANGERED OR THREATENED BUTTERFLIES

* Papilio andraemon bonhotei	FL
P. aristodemus ponceanus	FL
Euphydryas editha wrighti	CA
Poladryas minuta	TX
Speyeria adiaste adiaste	CA
S. nokomis apacheana	CA
* S. n. nokomis	CO
S. zerene hippolyta	OR
Oeneis chryxus valerata	WA
+ O. polixenes katahdin	ME
Apodemia mormo langei	CA
+ Calephelis nemesis dammersi	CA
+ Callophrys viridis	CA
Callophrys fotis doudoroffi	CA
*+Lycaena hermes	CA
+ Lycaena heteronea clara	CA
Philotes battoides (El Segundo pop.)	CA
P. enoptes smithi	CA
Plebejus icarioides missionensis	CA
P. i. moroensis	CA
P. melissa samuelis	NY,IL
+ Autochton cellus	TX
Megathymus coloradensis kendalli	TX

*ENDANGERED ONLY IN PART OF RANGE

+NOT INCLUDED ON OES LIST

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Editor's Note: It is interesting to note, of course, the substantial overlap of the two lists, which adds credulity to both. We will anticipate dialog between OES and XS on those taxa omitted from either, as well as regards future additions. Why is California so well represented? Simplistically, because DIVERSITY + OVERPOPULATION = EXTINCTIONS.

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As announced in the previous issue of Atala, Dr. Paul Opler has been appointed Staff Specialist in entomology at the Office of Endangered Species, Fish and Wildlife Service, United States Department of the Interior. In this position Dr. Opler is the primary public figure dealing with rare insect conservation. It is his job to apply the Endangered Species Act to insects. Paul brings to this difficult assignment a great deal of research experience in the ecology and natural history of Lepidoptera, both in temperate and tropical regions. He is one of the most widely published young lepidopterists in the country. The Xerces Society feels fortunate indeed to have someone of Opler's scientific stature and conservation commitment in this vital government role.

Dr. Opler kindly consented to the following interview, conducted by the Editor on April 3, 1975 in Washington, D.C.

PYLE: Paul, the most frequent and difficult question asked of the Xerces Society, by the New York Times or whomever, is "what good is a butterfly?"

OPLER: I tell them, as far as humans are concerned, most butterflies are neutral, born and dying unseen. But they have a role as pollinators as well as esthetic value, scientific value with respect to studies of genetics and population biology (such as those of Paul Ehrlich), of migration and mimicry. On the negative side, a few butterflies are serious economic pests -- in this country one might mention the Alfalfa Butterfly, the Cabbage White, the Pine White and a few skippers on lawns.

PYLE: So you think, perhaps, that half or one per cent might be negative, most neutral and a few beneficial, economically speaking?

OPLER: Right. But as regards extinction, it can be natural. All species would become extinct without humans, eventually. But we tend to accelerate the process, so that butterfly extinctions are one symptom of the damaged environment.

PYLE: Do we need to save butterflies strictly for human needs, rather than for their own sake?

OPLER: Not necessarily. We make our decisions based on the biological circumstances surrounding species, but not on whether or not a species is demonstrably beneficial, or even whether conservation might cause disruption to planned human activities or development.

PYLE: Of course most of us feel that way, but there are those who contend that in a political sense, if public money is to be spent it should be for human welfare alone.

OPLER: We in this office make the biological decisions; it is up to others to make the political decisions. Eventually, if there is a conflict between an endangered species and some seemingly important human activity, it will rest with the courts.

PYLE: Of course that leaves you free to deal directly with conservation. Now, with respect to the California extinction syndrome, some of our colleagues liken butterfly losses to litmus paper or to the canary in the coal mine -- that is, an indicator of ecosystem health. Do you think this concept has worth?

OPLER: To an extent. Birds, butterflies, anything we are aware of shows that as the extent of manipulation increases, so does the rate of extinction. So butterflies certainly can be a living documentation of environmental quality.

PYLE: What is the biggest problem?

OPLER: At a recent symposium, it was said that *Homo sapiens* reached the carrying capacity of the earth for our species, and has been conducting stopgap measures ever since. So ultimately we're recording the demise of the earth's biota; our work is a holding action, to prevent some extinctions temporarily and to slow down the process as best we can. If civilization continues at the rate it's going, at least 50 per cent of the world's biota will become extinct in very short order.

PYLE: So would you concur in a basic belief that the conservation of diversity in our own time is inimical with current population growth; that to have butterflies, we must stabilize?

OPLER: Yes. The more people there are on earth, the more land that is needed for agriculture and for many other purposes.

PYLE: We have been impressed by your accomplishments in the short time you have been on the job. What are your basic objectives beyond the initial listing of threatened and endangered species?

OPLER: Listing is not the goal in itself, but the preservation of habitat. We may achieve that before a listing becomes final, or we may get the listing only to see the species become extinct. So the listing itself is of no great significance, unless it helps to preserve the species listed. In compiling the first proposed list of 41 taxa, we made an attempt to include all U.S. species and subspecies which are threatened or endangered. There may be as many as 20 more if we examine the situation very carefully. Before we can go to the Federal Register with a proposed rule-making, however, we need very careful status documentation for many of the 41 species and subspecies in the Notice of Review. This means provision of past and present distribution records by amateur and professional lepidopterists, along with habitat information.

PYLE: We'll return to that. Would you please outline "threatened" vs. "endangered" status?

OPLER: These are subjective definitions; each species is judged individually on the merits of its case. Endangered implies that species may become extinct in the near future; threatened suggests that species may become endangered in the foreseeable future, due to some change in the organisms' environment.

PYLE: Some lepidopterists, perhaps not thinking ahead to how they will be benefitted by the preservation of habitat, are worried about their collecting being curtailed by application of the

Endangered Species Act to butterflies. Will the rule-makings affect collectors significantly?

OPLER: In those cases where the butterfly is on the verge of extinction and becomes listed as endangered, there would be a prohibition against collecting of that species or subspecies. However, I think most lepidopterists would grant that it is better to be inconvenienced by a regulation than to permit the demise of a population. In cases where collecting of specimens or study of life history or ecology is necessary for conservation, federal permits can be granted for the study of endangered species. With respect to threatened species, my general feeling is that collecting in most cases would not be a factor either way in the decline or increase of the species, so the "taking" prohibition would not usually be applied to threatened species.

PYLE: Paul, what is your opinion of the relative importance of habitat alteration vs. pesticides vs. collecting in Lepidoptera diminution?

OPLER: I would say that alteration or destruction of habitat accounts for perhaps 99 per cent of the problem of disappearing species or unique populations. The impact of insecticides and overcollecting might account for the other one per cent. To my knowledge, there has never been documented the extirpation of any species, subspecies or population of any terrestrial insect due to either overcollecting or pesticides. I should emphasize that pesticides are generally not good things to introduce into the environment -- I am not in favor of biocides, far from it. But often places where very rare butterflies occur do not coincide with the areas where insecticides are used heavily. In addition, I think most people would grant, just from the history of success or failure of insecticides, that they certainly have not caused any of our economically damaging species to become extinct.

PYLE: That's certainly true, though it may be different for some non-target insects. I believe that some of the British researchers, Frank Moriarty among them, have shown that there can be certain sublethal effects of spraying upon fecundity; and we know of local die-offs in areas of heavy spraying of certain chemicals. But the evidence so far suggests that the general level of pesticides in the environment may not affect butterfly populations as much as is often thought.

OPLER: Right. Rachel Carson and those in her wake held the view that broad-scale use of insecticides in eastern forests to control Gypsy Moths and Tussock Moths caused broad-scale decline in the numbers of butterflies. This may have happened, but it has not been demonstrated to me. Determination of species and numbers needs to be done before spraying and careful monitoring of recovery following cessation of spraying carried out, and to my knowledge this has not been done.

PYLE: Are there really fewer butterflies today?

OPLER: In some places, surely; but probably not overall. Certain species have become extremely abundant while others have declined. People's impressions of relative abundance of butterflies may be quite colored by what they have read and the fact that they just may not go into environments where butterflies are. Often butterfly collectors, as they grow older, no matter in what decade, state that butterflies are less common than they used to be when they were young. Well, usually the best correlation with that observation is that as they grow older they often do not spend as much time looking for butterflies and consequently do not see as many as they used to when they went into the field more frequently.

PYLE: I agree. Still, I think we can agree that in any case, OES and the Xerces Society would not be happy to see a repeat of the DDT permit granted to the Forest Service for use against the Douglas-fir Tussock Moth in the Pacific Northwest last year.

OPLER: No. DDT has clearly had a serious impact on a number of species of birds high in the food chain.

PYLE: So we can agree that habitat is virtually the entire issue. How would you say, faced with the gigantic scale of habitat deterioration and replacement, that Xerces members can best aid the Office of Endangered Species in its mission?

OPLER: One of the best ways is provision of local lists and counts of species, particularly those which may be candidates for listing. We are very interested in any such data. One of the either fortunate or unfortunate things, depending on how you look at it, is that there are not very many butterflies in the eastern U.S. that fit the category of candidates for endangered or threatened species listing. The Bog Elfin in Maine, the Karner Blue, Hessel's Hairstreak and the Rare Skipper seem to be the primary candidates. Possibly the Diana Fritillary, some localized bog species of skippers and Bolorias may be others.

PYLE: Ecologically speaking, why are there so many more rarities in the West, when the East has been settled for so much longer and perhaps altered even more? Is it because more groups evolved in the West to a greater degree of specialization?

OPLER: Generally speaking, the distributions of butterflies in the East are relatively homogeneous and their occurrences are often quite broad. Therefore a single environmental change would not have a serious impact on most species. Whereas in the West, which is more mountainous, there are stronger gradients of rainfall and temperature change patterns, and more variety of geographic formations. So there is a much greater extent of endemism in the butterflies -- on isolated mountain peaks, on particular soils such as serpentine outcrops, on localized systems of coastal sand dunes or in a few marshes in the intermountain area -- and all of these areas subject to more and more rapid change. California seems to have the lion's share of these candidates -- and California is the most populous state, as well.

PYLE: So that emphasizes the fact that where there are more people, the incidence of butterfly

(continued on p. 18)

SOME PROBLEMS IN THE PRESERVATION OF BUTTERFLIES IN POLAND

by Jerzy S. Dabrowski

The phenomena of degradation and impoverishment of our native entomofauna, particularly during the past quarter-century, causes more and more anxiety. Butterflies, which recede while civilization expands, best illustrate the intensity of these processes. The alterations in landscape due to the development of human populations were of mechanical types up to the nineteenth century. By the clearing of forests, the chief plant formation in this climatic region, as well as by amelioration, thousands of square kilometers were turned into a "cultivated steppe" whose biocenosa were homogeneous. The industrial revolution followed by the sudden growth of technical civilization in the twentieth century brought about new factors quite unknown to the earth before. These are mainly "chemicalization" and, closely connected with it, intoxification of the natural life environments, and the application of artificial sources of light. The process of chemicalization started at the end of the last century with the use of fertilizers on a large scale. Application of pesticides to destroy the field pests and noxious insects began in the 1940's. The use of oil and later electrical illumination to light up the streets has been a selective factor on night insects in recent decades. Technology has also brought widespread physical disruption of habitats on a scale never seen during the many centuries of the growth of Europe up to modern times.

Certain insect species are already extinct and we constantly observe additional populations dying out. Among them, butterflies and moths are dominant in number. They seem to give way to those insect species which have a dynamic ability to adapt themselves quickly to new environmental conditions. These frequently become agricultural pests. While investigations on pest insects are numerous, there is a lack of basic inquiry into the causes of extinction and strategies for preservation of the native entomofauna. Polish insects may be threatened even in the territories which belong to the system of nature preserves.

Of all the insects which are attracted to artificial lights, rare and local species seem most exposed to danger as they may not be able to return to their very specific habitats. Besides, many individuals become injured or destroyed when they crash against burning bulbs or lamp casings. Not only bats but also insectivorous birds gather around lights to prey upon the moths and other insects. It is possible that these predators select the rarest species as being novel and more attractive than the common sorts.

Another mechanical mortality factor is motorization. An attempt to work out a sum of all the butterflies and other insects which are struck and killed by motor cars all over the crowded country roads might lead to astronomical figures. At night the effect increases as cars become moving light traps. Everyone who has to clean crushed insects from windshields during summer rides is aware of this problem.

What are the possibilities of survival for those species whose ecology and ethology allow them little adaptation to these modern changes? The facts, so far, do not encourage optimism. The official Decree on animals species preservation in Poland, which included four butterflies and moths, has not fulfilled our hopes since it came into force in 1952.

Today, twenty years since the Decree was made, we can state with confidence that it has not affected the status of any of the listed species of butterflies: _Papilio podalirius_ L. (Scarce Swallowtail), _Parnassius mnemosyne_ L. (Clouded Apollo), _P. apollo_ L. (Apollo); or the moth: _Acherontia atropos_ L. It was in any case a mistake to include _A. atropos_, which arrives annually from the south and is therefore not a breeding member of the Polish fauna. Other species exist which should have been on the list long ago; but placing them on it now will probably not save them, so far have the changes in their habitats progressed.

It seems that the active preservation of habitats in their unaltered state is the right way to proceed. If necessary, we can improve the conditions by an active form of interference leading to successional management and habitat reconstruction. Is this possible, and to what extent?

Polish territory is occupied by agricultural lands (49%), by industrial areas*(39%), and by areas of open space difficult of access and unaltered by civilization. This third category includes the tiny percentage of the land preserved as nature reservations and national parks -- only .53 % of the total. Unfortunately, the nature reserves in most cases are small enclaves scattered among the vast stretches of altered landscape. The lack of sufficient buffering from intensifying technological changes is a highly destructive condition for these last refuges of natural biocenosa. Habitats cannot resist the invasion of non-indigenous organisms. Artificial afforestation leads to overgrown communities where scrub and timber dominate herbs. As a result, insect diversity suffers.

The passively protected species such as _P. podalirius_ have already disappeared from the vicinity of Kraków and even from the nearby Ojców National Park where it used to fly in great quantities several years ago. The last stands of _P. mnemosyne_ in the Sudetes and the Carpathian Mountains are likely to disappear. These strongholds simply have not enough buffering from outside influences.

In addition to world-wide phenomena such as radioactive and chemical pollution, there occur more local factors whose destructive powers can be abated by the means applied science offers us. Intoxification of biotopes and ground and surface waters could be avoided.

*"industrial" here includes urban

A relatively new factor, mass tourist movement causes not only the destruction of insects in places of intense recreation, but also the treading upon of delicate microhabitats which are the feeding sites of caterpillars of a great many insect species. This influence can be modified, however, by careful planning. The intelligent placement of bright mercury-vapor lights can save hundreds of thousands of nocturnal insects. Yet such lights are installed not only within the buffer zones around national parks but also in the center of the natural monument reservations of the Tatra National Park. In contrast, the Board of Directors of the Ojców National Park have taken special care to see that the sources of illumination installed in their territory are those kinds which do comparatively little harm to the entomofauna.

Yet in spite of efforts to minimize human impact upon insect rarities, much more needs to be done. I have reserved for special discussion the Apollo (P. apollo), which is a classical example of how futile the attempts at preservation can be. Since the end of the nineteenth century this species has been endangered and it has finally vanished from many European stands. While it used to occur in Sadecki Beskid, in the Bieszczady Mountains, in Teschen Silesia, and in the Sudeten Mountains, the Apollo has survived in Poland only in the mountainous, subalpine reaches of Pieniny and Tatra National Parks. Even in Tatra the species has lost ground, certain populations having become extinct in little valleys. Collectors illegally take great numbers of P. apollo, whose commercial demand ever increases.

The extinction of this butterfly from the Pieniny National Park on the Dunajec River would be a great loss to Polish naturalists and scientists. This may occur as a result of overcollecting and its habitat becoming overgrown by forest. [Ed. note: This does indeed appear to be one of the few cases in which collecting may be a real factor, along with habitat loss.] During the years 1950-65 three colonies have been known to become extinct in that vicinity. The remaining three, the last ones, are likely to be gone soon from the summits of the park. All the alarms directed to the authorities of the Nature Preservation and Scientific Council of the park in this matter have not brought any results. There is a genuine fear that this beautiful butterfly will disappear from the Pieniny National Park inevitably.

Parnassius apollo L.

from the Pieniny National Park, POLAND.

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CONSERVATION OF Pieris virginiensis IN ONTARIO

by Quimby F. Hess

The status of the West Virginia White (Pieris virginiensis Edwards) in Ontario has been of concern to certain lepidopterists since 1969. Despite a recent organized search, it is believed to exist in Ontario at present in only two localities, both within the Niagara Escarpment region. A viable colony is present in Halton County about twenty miles west of Toronto near Campbellville, and a smaller, precarious colony has been located on Great La Cloche Island in the North Channel of Lake Huron. Both finds were made by members of the Toronto Entomologist Association.

According to specimens in the Royal Ontario Museum, Toronto, and the Canadian National Museum, Ottawa, the butterfly has occurred in Ontario in Hamilton (1881); London (1900); Etobicoke (1955); Cambellville (Halton County Forest) (1965 - 1974); and Great La Cloche Island (1973 - 1974). The insect has also been collected near Montreal (Province of Quebec) (1898, 1903); Ile Perrot, Quebec (1945, 1950) and St. Hilaire, Quebec (1900). It is now considered extinct in the Ontario and Quebec localities, excepting Halton County Forest and Great La Cloche Island. According to Bethune (1894; 1896), form virginiensis also occurred at Fort William and Orillia.

How the Butterfly was Found in Ontario

On the basis of Bethune's reference, A.M. Holmes studied topographic maps of the Hamilton area and was attracted by the large (two square miles) wooded area around Campbellville. On May 9, 1945 he visited the area and soon found Toothwort (Dentaria) abundant. After only a little exploration Holmes came upon P. virginiensis. Employing similar tactics of detection, R. Tasker noted the occurrence record for the butterfly in the British Museum of Natural History for "Grand La Cloche Island" reported by B.C.S. Warren (1963, Entomol. Ts. 84: 1-4). Gathering local knowledge in the Manitoulin region on the occurrence of Toothwort (Dentaria diphylla) and checking out reports he found one stand of the plant, in which he collected four specimens of P. virginiensis on May 20, 1973 and three individuals the following year on May 18, 1974. This is an area of one square mile being heavily exploited for firewood and also being cleared for farming.

Protection of the Butterfly

By 1969 heavy collecting pressure on the virginiensis colony near Campbellville, as well as the surrounding urbanization developments, began to alarm certain members of the Toronto Entomologist Association. Fortunately, the main part of the butterfly colony was centered in a portion of the Halton County Agreement Forest (owned by Halton County and managed under agreement by the Minister of Natural Resources) known as the Currie Tract. The site is located in the southern two-thirds of the eastern half of lot 9, concession IV Nassagaweya township, ca. 43° 40'N.L., 79° 59' E.L. This entire region is wooded as is much of the surrounding area, so that forest is essentially continuous over an area of at least two square miles.

The woodland vegetation is of a climax hardwood type consisting mainly of maple but with additional species. The area is notable for its extensive and dense stands of Toothwort (D. diphylla) which is the host plant here for P. virginiensis. Not only does Toothwort grow in great clumps in these maple woods, but it is also frequent and widespread in the form of single plants and smaller patches (Catling, et. al. no date given). Any clearing of the forest would bring about changes that could have a serious effect on the butterfly population, either through isolation (as by roads, transmission lines and the like), or through direct habitat destruction by urban development, fire or herbicide application.

In 1969 the writer, through his work (as a forester) with the Ministry of Natural Resources, suggested to the Toronto Entomologist Association that the Minister be made aware of the value of maintaining the Currie Tract, in part, as the habitat of Pieris virginiensis. Key personnel in the Ministry were advised of the special interest and they co-operated in protecting the habitat. In 1971 Dr. Paul M. Catling followed up the contact with the Ministry of Natural Resources in the matter of preserving lands for the West Virginia White. The result, during the period 1969 to 1974, was that Ontario government officials became aware of the special resource which was present on the Halton Forest in the form of this pale, white butterfly. The Association received assurances that the particular habitat requirements of virginiensis would be protected and maintained, and this has since been the case.

With the passing of the Endangered Species Act of 1971 in Parliament, the Association decided unanimously in 1974 to work toward the official placement of this butterfly on the list of endangered species under a regulation of that Act. This can be done by the provincial government. The achievement of this endeavor was neared in March, 1975, when a brief was submitted to the Minister of Natural Resources over the signature of Association President, Dr. A. Gordon Edmund. This, coupled with the assistance of other interested people, should result in success.

Thus, the citizens of Ontario, through their government, will provide the butterfly Pieris virginiensis with a better chance for survival against human encroachment upon its northern haunts.

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ISLE ROYALE

Where Butterflies are Protected from Progress

by Jennifer Slade

The seaplane gathered speed in the water, rose just in time to miss the lift-span bridge joining Houghton, Michigan with its twin city across the bay, Hancock, and turned into the early morning haze. Our destination was Isle Royale National Park in the northwestern corner of Lake Superior. We were to spend the summer observing the moose on the island and gathering data for my friend's doctoral thesis. However, as an amateur lepidopterist, I was soon to discover that the same features which make the island a unique place for observing the interaction of the moose and the wolves, furnished a varied fauna of moths and butterflies for me to watch as well.

The island is a wilderness area where the only transportation is by foot along the trails, across waterways and portages by canoe, or around the periphery of the island by boat. There are no roads and no automobiles. Visitors have access to the island only <u>via</u> limited-capacity boats or by charter flights aboard seaplanes. About 16,000 visitors make the journey to Isle Royale in an average summer. The closest land is Thunder Cape, Canada, fifteen miles to the northwest; Grand Portage, Minnesota, is twenty miles northeast while Michigan lies fifty miles to the south across Lake Superior (see map below). Thus the 210 square-mile national park is located right in the transition zone between the hardwood forests to the south and the boreal forests of the north country. The island reflects this interface both in its flora and in its fauna. Sugar Maple - Yellow Birch forests follow the relatively warm and dry Greenstone Ridge which forms the backbone of the long, narrow island. (Isle Royale is forty-five miles long and seven miles across at the widest point.) The frequency of Paper Birch and Quaking Aspen stands attest to the past history of fires on the island. White Spruce - Balsam Fir forests grow along the cooler, moister coasts and dominate the northeast end of the island. Scattered over the island are clearings (meadows left from mining and fishing settlements and areas where the bedrock has not accumulated enough soil to sustain much vegetation), and bog and swamp forests with Black Spruce, Northern White Cedar and a few Tamaracks. The juxtaposition of habitats and the relative isolation of the island has drawn various expeditions during the past century, of which we were the latest. Past explorers trooped around the island accumulating lists and specimens of plants, mammals, birds, fish, reptiles and some insects. Over the years, however, insects have not received their fair share of attention. Only recently the butterfly and moth fauna has become better known (Moore, 1960 & 1955; Nielson, 1970).

We arrived at Windigo Ranger Station, the headquarters for the southwest part of the island-park, in late May of 1974. One of the first butterflies I noticed was the Silvery Blue (<u>Glaucopsyche lygdamus</u>). This is essentially a northern species, usually found flying two or three feet above the ground in open woods and fields. We followed it through Strawberry Meadow until it disappeared over the tops of the Thimbleberry at the edge of the Yellow Birch forest. The larvae of the Silvery Blue feed on <u>Lathyrus ochroleucus</u>, the Yellow Pea, and often are tended by ants -- an interesting relationship exhibited by various blues. Another lycaenid flew around the fields at Windigo and on Washington Island at the mouth of Washington Harbor. Called commonly the Greenish Blue (<u>Plebejus saepiolus</u>) this typically northern species has very recently extended its range from California, Oregon and Washington through southern Canada as far east as Maine (Klots, 1954). The larvae likely feed here on clovers, species of which were introduced to Isle Royale mixed with the hay that the miners brought over to feed their horses in the nineteenth century.

More common than the blues was the Tiger Swallowtail (<u>Papilio glaucus canadensis</u>). This subspecies found on Isle Royale reaches its southern limit around Minneapolis and St. Paul, Minnesota, which is also the northern limit of the range for the more typical <u>P. glaucus glaucus</u>. Sometimes described as a "flying flower," this butterfly was conspicuous along the Washington Harbor trail, alighting on the purple thistles in the grassy field. One day we came across half a dozen apparently feeding on the muddy area along Washington Creek. This area, known as the Salt Lick because of the high concentration of various minerals in the soil, is a favorite spot for moose -- which stand with legs splayed slurping the "salty" mud. Whether the butterflies and the moose seek the same thing in mud or not, its attraction seems to be equally intense for both kinds of animals.

Coming back from the Salt Lick we spotted along the trail the Arctic Skipper (Cartero-cephalus palaemon mesapano); the Mountain Silverspot (Speyeria atlantis), which is primarily a Canadian Life Zone species; the Green Comma (Polygonia faunus), an animal limited to northern forest environments, and Compton Tortoiseshells (Nymphalis j-album), conspicuously feeding on the sap of a damaged spruce tree back in our camp. All four of these butterfly species are brightly patterned with orange and black, and are related, except for the skipper.

During July, a frequent visitor to the Washington Harbor campgrounds was the White Admiral (Limenitis arthemis). Very prominent with striking white bands on a velvety black background, it would teasingly settle on a spruce bough just above our heads and then flutter down to sun on a picnic table. This beautiful butterfly also favored damp spots around the shelters and if frightened away would circle around and return to the same or a nearby spot. Another black-and-white lepidopteran on Isle Royale is the White Underwing (Catocala relicta), which ranges from the northern portion of the Appalachian subregions west to Colorado and Oregon. Resting in the characteristic position of moths with wings folded over its back, this moth will flash its white-banded underwings to startle would-be predators.

Most moths on Isle Royale are less conspicuous than the White Underwing; not so the several sphinx moths, which even casual watchers often spot. Nonetheless, the Hummingbird Clearwing almost escaped detection as such. Hemaris thysbe mimics bees very effectively, and that is just what it appeared to be when I saw it busily nectaring in a field of buttercups. Other sphinx, or hawk moths were more obvious. For example, an early morning visitor to the Ranger Station might find the large Waved Sphinx (Ceratomia undulosa) resting on the wall below the porch light which had dazzled it the night before. The number of Sphingidae collected that summer suggests many more species of Lepidoptera may inhabit Isle Royale than are presently known to do so. Of six species of sphingids which have been found on the island, three turned up in 1974 for the first time! We discovered two because they took shelter at night in our tents -- Cerisy's Sphinx (Smerinthus cerisyi) and the Blinded Sphinx (Paonias excaecata). As it turned out their camping with us was more social than selective: they became a favorite prey for the large fishing spider (Dolomedes tenebrosus) which found the tents to be great hunting grounds.

Still other sphinx moths find their main larval foodplants abundant in the national park. For the Snowberry Clearwing (Hemaris diffinis) the main understory of the birch woods provides honeysuckles and Snowberry. For the big Poplar Sphinx (Pachysphinx modesta) there are pure stands of aspen which grew up after fire cleared off climax vegetation. One such large Quaking Aspen stand can be found along the trail to Huginin Cove on the northwest shore. Here the watchful person might spy the blue and pink "eyespots" of a Poplar Sphinx, as it opened its great tan wings in preparation for evening flight.

The current faunal count for Isle Royale stands at forty-five kinds of butterflies and approximately 100 moths. There are probably many others; I suspect these figures could be about doubled for butterflies and increased perhaps eight-fold for moths if the entire fauna were known. In the meantime an up-dated list of the Lepidoptera of Isle Royale, based on past records and recent collecting, will be in press soon.

You and I are fortunate that Isle Royale is preserved from the habitat-eliminating human activity which occurs often in unprotected areas. Isle Royale has been exploited by people for at least 4500 years, but the changes have not been great and the effects are disappearing with time and succession. The present status of Isle Royale as a wilderness national park ensures that the diverse habitats and transitional forests will be affected only by the natural forces of fire and wind and moose and insects.

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I. Speyeria zerene hippolyta in Oregon
by David V. McCorkle

[Xerces Society Chief Counsellor David McCorkle has been pursuing protection for the Hippolyta Silverspot in his Northwest homeland for several years. The Society joined the effort in 1972 by contacting Senator Mark Hatfield and others to raise awareness of the special resource. The Hon. Senator demonstrated his alliance to XS by asking officials of his state to cooperate in every way possible to protect habitat. This conservation consortium (already involving the Oregon Highway Commission, The Nature Conservancy, the Oregon Entomological Society, the Xerces Society and Senator Hatfield) broadened when Wildlife Biologist Gene Silovsky of the U.S. Forest Service requested the aid of XS in arriving at a management formula for the Siuslaw National Forest which would deal with S. z. hippolyta as a key wildlife species. The entire operation continued to pivot on Dave McCorkle, whose notes have been compiled into the following article.]

BUTTERFLIES OF THE GENUS SPEYERIA (Nymphalidae) are among the most interesting insects in North America. This is due largely to the marked degree of geographic variation found among most of the thirteen species occurring on this continent, a fact which has led to the recognition of many subspecies. This, together with the close similarities among several of the species, suggests strongly that the fritillaries of the genus Speyeria are presently undergoing a comparatively rapid rate of evolution toward additional speciation.

Oregon is one of the richest states in number of species (8) and subspecies (22) in this genus. The single species S. zerene alone has evolved seven recognized subspecies which occur within Oregon. One of these, S. z. hippolyta, is restricted to salt spray meadows in the immediate vicinity of the shoreline where its larval foodplant, Viola adunca, grows. Habitat for this subspecies is dwindling rapidly. It would seem to be highly desirable to establish a preserve for this butterfly and for the many other native organisms which make up the salt spray meadow community. There is widespread support for this action from Oregon entomologists and from lepidopterists and others throughout the United States. Such a preserve would provide the gene pool necessary for future research into the role of this subspecies in the systematics of North American Speyeria. S. z. hippolyta is of particular ecological interest because of its physiological adaptations to rigorous coastal weather conditions eschewed by most other butterflies.

In addition to providing research material, stock of this endangered butterfly would be available for introduction to other natural areas along the coast which may someday be re-established. While introductions must be approached with great care, future generations of land managers may decide to "landscape" with other components of balanced ecosystems than plants alone, if for no other reason than that such systems can be homeostatic.

One more excellent reason for perpetuating this animal is that it constitutes an absolutely unique and superb resource for the State of Oregon -- a resource known variously as the Oregon Silverspot or Hippolyta, a name taken from the beautiful Queen of the Amazons in Greek mythology.

Preservation of Salt Spray Meadow Habitat

Natural salt spray meadows are found on non-sandy soil in coastal localities which are directly exposed to storm winds. They are composed of a large variety of native, salt-tolerant herbaceous plants including many grasses. Few shrubs or trees can survive here. The community of organisms found in these special meadows includes native mammals such as the well known Roosevelt Elk, which leave the inland woods to graze them at night. A much smaller inhabitant, completely endemic to these meadows, is the Hippolyta Silverspot.

Like the other indigenous organisms found in these seaside meadows, the butterfly helps maintain the ecological balance. Its caterpillars find sufficient violet leaves for their nutrition as long as natural parasites and predators regulate caterpillar density to the level which violet overproduction can support. The adult butterflies, on the wing during August and September, help pollinate the native aster and other summer wildflowers as they take nourishment from their nectar.

Only two natural salt spray meadows of appreciable size and nurturing S. z. hippolyta are known to exist in the world. All others have been either replaced or severely reduced in extent by the construction of buildings, by paving, by the planting of lawns or by overgrazing of domestic animals. One of these remaining meadows, at the mouth of Tenmile Creek in Lane County, is mostly privately owned and apparently is destined to become the site of a California company's condominiums. This will leave a strip of meadow one-half mile long and about 200 yards wide, lying on either side of U.S. Highway 101, as the sole surviving stable example of this type of ecosystem. Most of this linear habitat, located between Rock Creek and Big Creek in Lane County, lies within the boundaries of the Siuslaw National Forest and is presently inventoried to be managed for the Hippolyta Silverspot. A public ceremony will take place on June 22, 1975, in conjunction with the Pacific Slope meeting of the Lepidopterists' Society in Corvallis, when the Forest Service will officially dedicate this site as a hippolyta habitat reserve.

The sand dunes of the central Oregon coast apparently have served as a barrier to the spread of the Hippolyta Silverspot southward. There exists one remaining sizeable colony of the Behrens' Silverspot (S. z. behrensii), a close but larger and paler relative of hippolyta, on state-owned land at Cape Blanco.

The salt spray meadows here are especially rich in native wildflowers. The new Cape Blanco campground has been designed thoughtfully to minimize destruction of the surrounding vegetation, and park regulations protect all organisms from visitor damage. But unauthorized off-road traffic is a continual threat to the stability of these sites. Elsewhere along the southern Oregon coast the nature of the seaside meadows has been changed due to years of overgrazing by sheep, so that they consist primarily of a few species of introduced grasses and weeds as their dominant vegetation. This fact underscores the importance of the Forest Service reserve.

Distribution of S. z. hippolyta

Subspecies Type Locality: Cape Meares, Tillamook County, Oregon (fixed by dos Passos and Grey), originally described from the "Oregon Coast" by Edwards in 1897.

Known localities for this subspecies, smaller and darker than the inland S. z. bremneri and with a delayed flight period (apparently an adaptation to the foggy summer weather on the Oregon coast), are given here with their current status: Near Westport, WA (Common in 1950, status uncertain now); Cullaby Lake area, Clatsop Co., OR (Once common, apparently now extinct); Near Gearhart, Clatsop Co., OR (Small colony found in 1973 on land posted for sale for commercial development. Habitat area already too limited to last long); Cape Meares, Tillamook Co., OR (Records as late as latter 1960's, but none in 1970's. Habitat very limited here due to natural erosion of the bluff); Boiler Bay, Lincoln Co., OR (Very small colony remains on private land); Newport, Lincoln Co., OR (One old record, colony now extinct); Tenmile Creek, Lane Co., OR (Presently a strong colony. Habitat is mostly between road and beach. It is private land slated for condominium development, except for 2 - 3 acres within a state park); Rock Creek to Big Creek, Lane Co., OR (and about .2 miles to the south) (Strong colony. This is the southernmost locality for true S. z. hippolyta. Apparently the sand dunes along the central Oregon coast constitute a biogeographical barrier to southward range expansion).

Cape Blanco and a limited area just north of Goldbeach in Curry County, Oregon, support colonies of S. z. behrensii, a subspecies known better from coastal meadows in northern California. Habitat undoubtedly existed at Brookings, Oregon, but has been displaced by urbanization and agriculture. A strong colony still occurs in a restricted area just south of the Oregon - California border. Two populations of S. zerene, apparently very similar genetically to hippolyta, are known from the tops of Saddle Mountain in Clatsop County, Oregon and Mount Hebo in Tillamook County, Oregon. Interestingly, S. zerene from inland Mary's Peak in Benton County, Oregon, is distinctively different -- it is larger, less dark and earlier in its period of flight. My study of the coastal forms of S. zerene has been in progress for seven years. The above information is a result of extensive examination of potential habitat sites along the entire length of the Oregon coast during this period. I consider it unlikely that any additional colonies of substantive proportions will be found.

Life History of S. z. hippolyta

The ova are laid in August and September, on or as much as one foot downwind of the foodplant Viola adunca. The larvae hatch in a week or two and overwinter without feeding. Diapause occurs on vegetation near the soil surface. The larvae break diapause and begin feeding in the spring when temperatures reach about 60° F, or perhaps sooner in direct sunlight. After five molts, they pupate in the meadow litter. The pupal stage lasts ten to fifteen days in the laboratory at room temperature; perhaps it is longer in nature with cold nights and foggy days. The males eclose in early to mid-August, the females up to two weeks later; thus there are females ready to take advantage of the sunny weather for mating whenever it may occur in late summer. Adults nectar primarily on the native Aster chilensis ? and other composites. As butterflies, hippolyta often shelter in the Sitka Spruce forest just inland from the meadow during frequent windy weather. Mating may take place primarily among the spruce, although this has not been confirmed. Oviposition may not commence for several days, perhaps even up to two weeks, after the females have emerged from their chrysalids. Flight continues during sunny periods until foul weather descends in late September or early October.

Some Management Suggestions for the Rock Creek Salt Spray Meadow

Present public use of the area for beach access means that off-road parking increasingly damages the Rock Creek end of the meadow between the highway and the beach. Positive action should be taken to establish a parking lot on the north bank of Rock Creek just inland from the highway; and to improve the trail to the beach along the north bank of the creek and under the highway, with the addition of directional signs. This will reduce traffic hazard to visitors and reduce pressure on the meadow. At present use levels, foot travel across the meadow need not be restricted. Increased pressure may require footpaths in specific places or other management steps. All vehicular access to the meadow should be blocked.

Due to the delayed oviposition by females, the comparatively small numbers of adults in the population and their limited opportunity for dispersal during the flight period, S. zerene hippolyta can be considered especially vulnerable to overcollecting, especially early in its flight period. Until now, passing automobiles have undoubtedly killed more adult silverspots than have collectors. However, in view of the publicity the reserve is receiving, it would be best to prohibit [or strictly limit? --Ed.] collecting within the preserve. Those needing specimens could obtain them from the Tenmile Creek site or from the small portion of the meadow lying just south of Big Creek, at least until these sites are severely altered by developers. Rearing of adults from two or three wild-caught gravid females should be encouraged. (Continued on p.17)

II. Speyeria nokomis nokomis in Colorado
by Scott L. Ellis

[As F.Martin Brown wrote in Colorado Butterflies (1957), "There is no more prized butterfly in Colorado than the Nokomis Fritillary." Due to its great beauty and relative scarcity over much of its range, this butterfly has been the object of intense interest for collectors and conservationists alike. More than any of its other admirers, Xerces Society Chief Counsellor Scott Ellis has plunged into the difficult politics and fascinating biology of the Nokomis Fritillary. Here he presents a chronology of events in the development of this vital issue, which should serve as a virtual instruction sheet and operational manual for others undertaking similar habitat conservation campaigns in rural areas.]

Speyeria nokomis appears to be a relict species that is restricted to isolated seeps and springs in arid parts of the Colorado Plateau and Great Basin (Ferris and Fisher, 1971). There are presently two viable populations of the type subspecies S. n. nokomis known in Colorado -- one in the Paradox Valley near the town of Paradox in Montrose County, the other in Unaweep Canyon near the town of Gateway in Mesa County. Because extensive searches for other populations have been made on a long-term resident basis throughout western Colorado, I consider it unlikely that more will be discovered. Clearly, the Nokomis Fritillary in Colorado represents a high-priority resource for conservation. For several years an effort has been underway to assure protection of the Unaweep Canyon colony. Here, then, is a record of events surrounding research into this particular population, and of avenues which have been followed in attempts to preserve it.

1. The Unaweep Canyon colony was discovered by John A. Justice and Scott L. Ellis in August, 1965. The colony has been monitored on a yearly basis since that time to detect possible fluctuations in Nokomis Fritillary numbers and habitat changes.

2. In August, 1966, I observed that extensive patches of burdock, a primary nectar source for Nokomis adults, had been eliminated with herbicide. The burdock was apparently bothersome to cattle grazing the area in the fall.

3. A visit to the site in late April, 1972 showed deterioration of the spring area from trampling by cattle. The site provides the essential damp conditions due to a seep, which emerges along a spring line in granite and flows over stream alluvium. In an otherwise arid region, this seep furnishes a moist substrate whereupon willows may grow. By browsing and trampling the willow thickets, cattle may damage the underlying violets which are S. n. nokomis' food plant. 1972 was a drought year, so cattle were heavily concentrated in the seep area because of a lack of forage elsewhere. At this point I became convinced that conservation measures should be sought to prevent further deterioration of the Unaweep site.

4. Ownership maps and records were inspected at the Mesa County courthouse to determine title of the Unaweep eep. The records showed that rancher Byrl Casto of Gateway owned most of the area, and the federal Bureau of Land Management (USDI) the rest. The relative portions owned by each was unclear due to poor resolution of the available maps. A more precise picture of ownership came together when I scrutinized the "Two V Basin" 15' Series USGS topographic map quadrangle; aerial photographs of the area, and BLM maps, early in 1974.

5. In May, 1973 I sent a description of the springs and their scientific value to Steve Smith, Recreation Planner at the Bureau of Land Management Office in Grand Junction. A July letter followed, this to the landowner Byrl Casto, outlining the scientific value of the lands, expressing hope that they would not be severely disturbed, requesting permission to enter his land for scientific research and extending a feeler to test whether he would consider selling this land. I did not really expect a response from Mr. Casto at this time, and none was received.

6. I called on the Grand Junction BLM office in September, 1973. At that time I was told that our proposal for BLM protection had been reviewed and sent on to the regional office in Denver. I was also informed that the agency was currently focusing most of its attention on the oil shale region of Colorado, and that planning in the Dolores River area (in which the seep is located) might be several years away. I came away from this meeting with a feeling that BLM was mildly interested in the Nokomis Fritillary but not greatly inclined to take positive action.

7. In late December, 1973, my father, my wife and I met with Byrl Casto in Gateway to talk more directly about the matter. Mr. Casto is a long-time resident of Gateway. His ranch, one of the largest in the area, lies along the Dolores River south of Gateway; it is here that he winters his cattle. In the spring, he drives (or trucks) part of his herd up Unaweep Canyon, where he pastures them on 320 acres of his own land, which includes part of the seeps, and also on federal land for which he holds permits. The cows remain in the seeps for a period of over a month (April 1 to May 15 in 1973), and then are driven eastward to summer range farther up the canyon and onto the Uncompahgre Plateau. In general, he adheres closely to the schedule shown on the BLM permit sheet. However, in some years he leaves horses in the seeps for several weeks after the cows are driven out. Since there are no fences between Casto's and the public's land, there is no way to prevent livestock access to any part of the spring area. The forage value of the Pinyon Pine - Juniper land surrounding the springs is very low, so nearly all grazing

pressure is directed at the seeps. In the winter, cows are turned back into the seeps to eat the standing dry matter which accumulated over the summer.

Casto has a grown son who will be taking over the family operations after his father retires; the continued success of the cattle business is uppermost in both their minds. Casto declined to state any price that he would take for his land, but indicated that if he would sell it, at least the whole eighty acres would have to go with it. From a practical standpoint, this makes sense because of the low value of the surrounding land for grazing purposes. I asked whether he would consider a land trade with the government. He said that he would, but that the BLM would "have to clip a lot of coupons" to get it. Naturally, he was uncertain about our motives for wanting to buy his land, and asked several times what sort of financial gains we hoped to obtain from such a transaction. My father, who qualifies as something of an "old timer," helped greatly to add credibility to our meeting, since he and Casto knew some other ranchers in common and so shared a sense of community. By virtue of my father's longstanding reputation as a fruit rancher in the area, we were able to establish ourselves as natives and thereby avoid some of the distrust which would be accorded complete outsiders. Casto gave permission for research to be undertaken in his part of the seeps, as long as we did not disturb cows with calves which would be grazing there in the spring of the year.

8. A meeting with Les Oliver, BLM regional official in Denver, was arranged. I was considerably encouraged by this talk: it seemed there was a good chance that the agency would consider a land use change if sufficient evidence for such a move could be produced. Oliver apparently sent some strong language back down the line to the Grand Junction office, as a palaver with local BLM officials several weeks later furnished much more enthusiasm for the project than had previously been evinced. I planned to go out with their field man to survey property boundaries and obtain on-site information. Unfortunately, we moved to Fort Collins in April, 1974, before such a reconnaissance could be made. The boundaries should be very easy to establish, however, since there is a marked section corner just east of the site.

9. Since the BLM encouraged us to seek private groups who might be interested in aiding attempts to preserve this area, I contacted The Nature Conservancy through Mr. Lloyd Hayes, of Fort Collins. After receiving a prospectus of the area, Mr. Hayes informed me that TNC was interested. During the early spring of 1974, Henry Little, Field Representative for TNC made a trip down Unaweep Canyon and by chance encountered Byrl Casto in Gateway. Subsequently, Mr. Hayes reiterated that TNC wished to continue efforts at protection of the Unaweep Canyon springs, and would be happy to cooperate with other groups which had similar objectives. Naturally, this includes the Xerces Society, which has been deeply concerned with Nokomis Fritillary conservation since the beginnings of the project.

10. I approached members of the biology department of Mesa College, Grand Junction, to obtain scientific expertise for an inventory of the seep; and to investigate the educational potential of the site as a field study area. Joan and Bob Young of the biology and geology departments responded with interest.

11. Mr. Oliver of the BLM suggested that we pursue the possibility of _S. nokomis_ being listed by the federal government as an endangered species. I wrote a query on this to the Fish and Wildlife Service. No reply was forthcoming, but in the fall of 1974 I learned through the Xerces Society that Dr. Paul Opler, an entomologist known to be strongly interested in conservation, had been appointed to the Office of Endangered Species as Staff Specialist in Entomology. One of his first priorities is to designate threatened and endangered U.S. insects. Designation of _S. nokomis_ as a threatened or endangered species by the OES would probably have a very beneficial effect on the negotiations underway with the BLM for land use changes in their part of this extremely limited and unique seep community. [Ed. Note: see "Endangered Species" on page 1 of this issue.]

12. In February, 1974, Mr. David Galinat of the Grand Junction Audubon Society agreed to accompany me to Unaweep Canyon to assess its quality as bird habitat. We saw few birds on this outing. Nonetheless, David expressed the desire to return in summer to observe nesting birds in the spring area. Indications are that the relative biological diversity of the proposed reserve will be high for most groups of organisms present. Additional interesting butterflies occur there, including an unusual population of _Pieris napi_ and the scarce fritillary _Speyeria cybele charlotti_. One would suspect that the seep furnishes a moist refugium in this harsh desert region for many species of vertebrates as well.

13. We are planning further efforts to study and conserve the Unaweep seep and its biota, including the Nokomis Fritillary. Some priorities at this time include: a) To establish property boundaries for the site with BLM surveyors. b) To conduct research on the population structure of _S. n. nokomis_, and on other aspects of its biology. In particular, autecological studies are needed. c) To make a comprehensive floral and faunal survey of the seep habitat. d) To obtain permission from the BLM to construct several cattle exclosures, in order to experimentally assess the effects of cattle grazing on the plant community. e) To maintain considerate contact and exchange with the landowners, particularly with regard to research activities on the springs; and to continue to educate the landowners about our genuine purposes. And f) To continue efforts to enlist the aid of private conservation groups in the protection of this unique area; and to encourage institutions and individuals to conduct ecological research in Unaweep Canyon and to make their results available for use in this ongoing campaign.

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Literature Cited: Ferris, Clifford D. and Mike Fisher. 1971. A revision of _Speyeria nokomis_ (Nymphalidae). _J. Lepid. Soc._ 25: 44-52.

New York State College of Agriculture and Life Sciences
a Statutory College of the State University
Cornell University

Department of Plant Pathology
334 Plant Science Building, Ithaca, N. Y. 14853

14 May 1975

To the members of the Xerces Society:

We are writing to you about the situation at the Karner Pine Bush at Albany, New York. Two lepidopterans, the Karner Blue Butterfly (Lycaeides melissa samuelis) and the Buck Moth (Hemileuca maia) are endangered there. The populations of both species are presently threatened with extinction by the proposed development of 350 acres in the centre of the approximately 1000 acres of undisturbed Pine Bush left. The accompanying map shows the relationship of the proposed development to the last remaining colonies of the Karner Blue and Buck Moth in the Pine Bush.

An Albany developer, Neil Hellman (address: 1365 Washington Avenue, Albany, New York 12205), has a contract to buy these 350 acres of Pine Bush wilderness and develop them into apartments, condominiums, factories, warehouses, and stores. His contract stipulates that the land must be rezoned from light density residential to a variety of lower zones including commercial, high density residential, and industrial. A public hearing was held before the Albany Common Council on 5 May 1975 to air opposition to the proposed rezoning of the Pine Bush land. Five Xerces Society members (Robert M. Pyle, Frederick C. Schlauch, Jim Cane, Robert Dirig, and John F. Cryan) spoke at the public hearing against the proposed rezonings. The Albany Common Council will vote on whether to rezone the 350 acres on 19 May 1975. Hopefully, they will vote no.

Even if the Council votes not to allow the rezoning, the developer can still resubmit his plans until they do allow the Pine Bush land to be rezoned. The only method that will convince the developer that it would be to his disadvantage to develop the land and destroy the populations of the Karner Blue and Buck Moth at the Pine Bush is public pressure. We desperately need your letters. It is in situations like this that Xerces Society members must unite and act. We ask you to take a little time and ten cents and write a letter to the developer at the above address, and if possible to send a copy of your letter to the Mayor of Albany, Erastus Corning II (address: Office of the Mayor, Albany, New York 12207). Please act now; the strength of the Xerces Society lies in the pressure that its members can exercise through letters. If you feel that you need more information on the Karner Blue and Buck Moth before writing to the developer, send us 25¢ for a copy of our booklet Endangered Pine Bush Lepidoptera which gives a detailed account of the natural history and present status of these two beautiful animals at the Pine Bush.

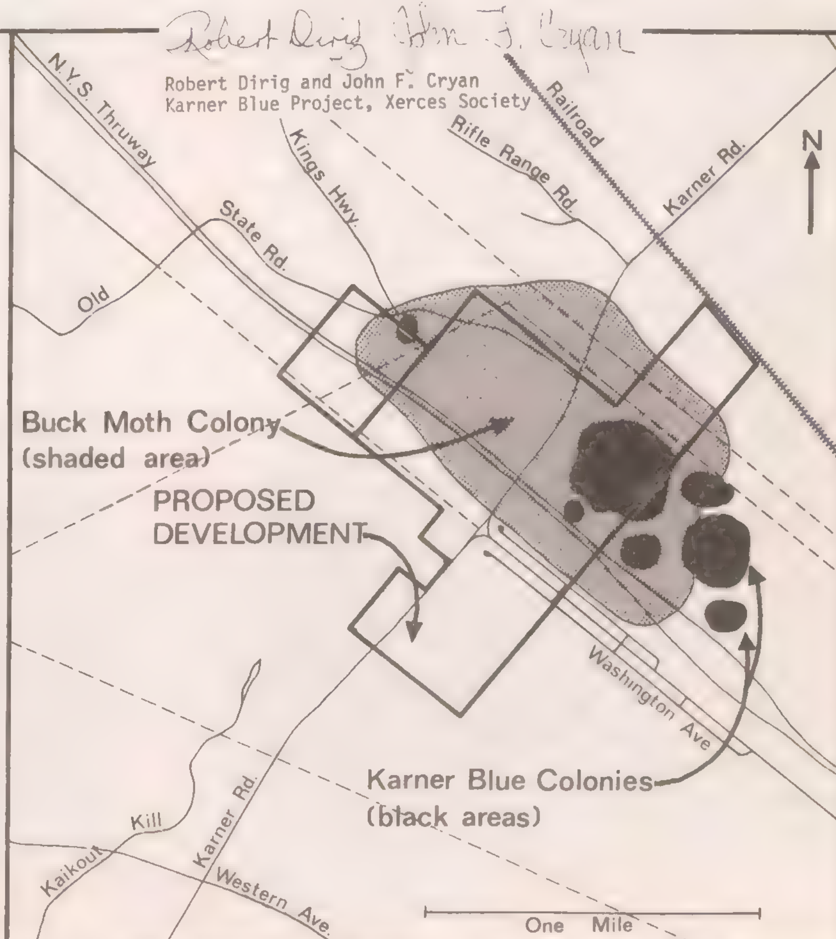
Thank you.

Most sincerely yours,

Robert Dirig John F. Cryan

Robert Dirig and John F. Cryan
Karner Blue Project, Xerces Society

This map shows the relationships of the Karner Blue colonies and Buck Moth colony to the proposed development. The boundaries of the moth and butterfly colonies are approximate and shift every year as new areas are opened up by fire. In their present location, however, both species will become extinct at the Pine Bush if the proposed development is allowed to occur. Because of encroaching development on all sides, the area that the Buck Moth and Karner Blue inhabit now will be their last stronghold; they can move nowhere else. This area of roughly 500 acres (which includes the 350 acres marked for development) is the last remaining vestige of a fire disclimax forest within the Pine Bush, which once covered 40 square miles. For the sake of these two insects and hundreds of specialized pine barrens plants and animals, it should not be allowed to fall beneath the bulldozer's blade.



REDISCOVERY OF A "LOST" UNDERWING MOTH

by Dale Schweitzer

The "underwing" or "afterwing" moths, genus Catocala Schrank, are familiar to most North American naturalists. They have long been popular with collectors and more recently with serious students of evolution, ecology and behavior. More than 100 species and many named variations occur in North America.

All underwing moths have rather somber forewings and bright, contrasting hindwings which are concealed at rest. In most species these hindwings are patterned with two black bands on a colored base, which may be yellow, orange, red or pink. One North American species is colored only in black, white and shades of gray and a similar Eurasian underwing has blue secondaries. Some eastern United States moths bear solid black hindwings with, at most, a bit of white on the fringes.

The moths fly in summer and autumn (from late June to mid-October in New Jersey) and lay their eggs mostly in bark crevices of the host plant. Larvae hatch in the spring and feed on the new foliage. Most, if not all species, use a rather narrow range of host plants. In North America many kinds of Catocala often feed upon the same host in a given area. Hickories, walnuts, willows, poplars, rose-family trees and oaks are widely exploited. Additional hosts for a few moths are heaths (especially blueberry), woody legumes, Bayberry and the related Sweetfern. "Cat" larvae are marvelously camouflaged on bark and among leaf litter and are powerful jumpers as well. They often hide in crevices by day. Feeding takes place by night for the most part. Pupation ensues among fallen leaves or under loose bark, in a slight cocoon. The adult moths usually emerge about one month later. They feed at sap flows, aphid "honeydew," rotting fruit and flowers, and come as well to "sugar" baits placed for them by Catocala enthusiasts.

We know little about the population dynamics of these moths. Clearly, their numbers and ranges change from time to time. For example, Catocala subnata has had mild "exlosions" -- at about the turn of the century, in the 1930's and from the late 1960's to 1971. C. marmorata (a giant of the genus) occurred not too rarely in northern New Jersey from about 1880-1910. Sid Hessel took one on Long Island in the 1930's and many specimens came from Amherst County, Virginia, during the same period. All of the more recent records seem to originate in North and South Carolina. The southern Appalachians seem always to have been marmorata's stronghold. On the other hand, C. judith and serena are now far more common in New England than ever known before. The southern species C. maestosa has recently invaded coastal plain New Jersey and became rather common by 1973. Since it flies very late in the season, the extreme cold waves of late September and October, 1974, doubtless hurt it; though it was present earlier that year. Many more examples could be drawn, but the point is that in many, if not all areas, these moths come and go in time.

There is some evidence of massive, multispecies movements of various distances. Occasional swarms invade cities and towns, especially in the Deep South. City parks occasionally support even "rare" species. Generally, however, most underwings are forest dwellers. Species diversity is often high in developed areas but in my experience numbers in such places are very low, suggesting that individuals stray from ecologically more suitable areas.

At the 1973 meeting of the Lepidopterists' Society a number of members expressed concern that one of the least known of our underwings, C. pretiosa, was extinct. [Ed. Note: This moth was featured on the previous issue's cover.] In fact, we are not even certain that this is a distinct species; certainly it is close to C. crataegi. Pretiosa differs by the much brighter white, often with iridescence, on the forewing, and by having this white extend to the inner margin of the median area. Crataegi is blackish on the inner margin. In the North Carolina mountains and Arkansas, at least, forms with chiefly crataegi characters apparently occur sympatrically with the related C. mira. For a variety of reasons I believe C. pretiosa to be a distinct species. But is it still in existence?

After an apparent total absence from new collections for over fifty years, Catocala pretiosa has come back. On 28 June 1968 Joseph Muller collected two males on coastal dunes not far from Cape May, New Jersey. Then on 7 July 1974 I captured a worn male near Batsto village in the Pine Barrens of New Jersey. Neither pretiosa nor crataegi were known previously from south Jersey! On 12 June 1974 Charles Horton took a male at Chapel Hill, North Carolina. A pattern began to emerge since all of these records, as well as the type locality on the Albany, New York Pine Bush, are sandy, acid soil areas. Presumably this species feeds on some rosaceous plant like all of its close relatives do. Whatever its natural history may be like, pretiosa's reappearance has been a happy, if bewildering, event. And another very rare Catocala, C. miranda, has recently shown up after a long absence in eastern Pennsylvania, the North Carolina mountains and coastal South Carolina.

How human activities affect Catocala populations is little known. Certainly some locales which formerly were well populated by these insects no longer support them, due to vegetational changes. However, some species which prefer disturbed sites have probably increased. At least five (grynea, ultronia, mira, crataegi and blandula) have adopted apple as an important host in Pennsylvania and north-central New Jersey. Three others have followed the planting of Honey Locust beyond its natural range. Nevertheless, clearing of forest lands and spring spraying over wide areas certainly must take some toll of underwing moths.

Fortunately, many of the species can adjust to -

human "progress," within limits. As for the others, the protection of certain key areas such as the Great Smoky Mountains and the New Jersey Pine Barrens (in part), as well as the continued occurrence of widespread wooded areas, should prevent them from joining the Xerces Blue in the near future. However, two very little known species (C. grisata of Georgia and C. louisae of northern Florida) may need special protection; and in almost all regions some locally important habitats are in precarious positions.

In addition to working to save such habitats, concerned persons can also help Catocala by planting local host trees and leaving some natural litter beneath them for pupation. Maintaining diverse woodlots can be another personal contribution toward underwing conservation, as can providing some sweet concoction upon which the adults may feed. It might be best if persons attempting the latter strategy marked some moths to discover whether they were becoming "trap happy." If too many females lay eggs in too small an area there is the danger that larval populations will become too dense and thus sustain an unnaturally high incidence of predation or parasitism. In that case, one's effort could turn out to be counter productive. As long as the moths do not return frequently to the bait, they are probably dispersing naturally and your free meal may bolster their strength. I would also suggest that you keep the alcohol content of your bait lower than if you were collecting, since drunken moths are fairly easy prey for many animals. By the way, published information on dispersal in Catocala is quite inadequate and your observations might well be valuable in themselves if published or at least communicated to an authority. It is just this sort of information, in fact, which will enable us to piece together a clearer picture of the remarkable changes in abundance which some species of underwing moths seem to undergo.

Readers wishing to obtain more information or to send in their own observations are invited to write the author: Dale F. Schweitzer, Entomology Section, Peabody Museum of Natural History, Yale University, New Haven, CT 06520.

(Editor's Note: The foregoing article was kindly written for Atala in response to the note about Catocala pretiosa which appeared in the previous issue. This once-presumed extinct moth, now rediscovered by Mr. Schweitzer and others, was featured on the cover of that number (Atala 2:2). Whether this and other rare "cats" are truly decreasing and endangered or merely responding to natural fluctuation stimuli is the kind of critical question we must pose to specialists such as Mr. Schweitzer. If you are interested in this captivating group of animals, be on the watch for Dr. Ted Sargent's book on Catocala; we will announce its publication. Also, be sure to read "On the Wing" in this issue, which carries news of a spectacular habitat conservation success in Wisconsin of great consequence to underwing populations.)

MANTIS MUNCHES MONARCH

(In his article on praying mantids and butterflies in the preceding issue (Atala 2:2) Terry Chester invited comment from other observers. What follows is the most intriguing response.)

by NOBLE PROCTOR

On October 10, 1972 while looking for late migrating warblers on Charles Island, located one mile off Milford Beach, Milford, CT, my wife Carolyn and I came upon a very strange sight. Scattered along the path edge in front of us was a long line of wings of the Monarch butterfly (Danaus plexippus). Only the wings! We backtracked along this line to find out the cause of this dismemberment. As we did so we counted the wing remains of eight Monarchs. At last the trail stopped and the originator was found. Perched atop a goldenrod was a Chinese Praying Mantis (Tenodera aridifolia sinensis), holding in its grasping forelegs a Monarch which had evidently settled on the same plant. The mantid fed upon the butterfy's abdomen and the wings fell to the ground, adding to the wind-blown chain which lined the path.

We watched the mantid ingest the entire body (abdomen, thorax and head) of the plexippus and then re-position itself, ready to snatch another victim. Knowing of the supposed distastefullness of this species of butterfly we were quite surprised and fascinated to see it being taken so readily by the predator.

* * *

(Author Chester was asked to read this unusual account. Here is his reaction.)

Meredith Munsey discovered on page 200 of Edwin Way Teale's Circle of the Seasons (Dodd, Mead & Co., NY, 1953) the consumption of a Monarch by an adult T. a. sinensis (Chinese Mantid). Mr. Teale's observation and Noble's remarkable find are the only references I have seen thus far of mantids eating Monarchs.

Why would a mantid consume a supposedly distasteful prey? The unpalatability of an insect depends on the amount and strength of its host plant's toxic chemicals and the insect's ability to sequester these compounds. Therefore, the Milford Point butterflies may not have been as offensive as some other Monarchs. See Dr. Lincoln Brower's article "Ecological chemistry," Scientific American 220:22-29, for more on this. Also, I have found in my own research on mantid feeding behavior that these predators vary individually in their responses to distasteful prey.

RARE BUTTERFLY SAVED BY AN EARTHQUAKE

by Larry J. Orsak

Those who have tried to save butterfly populations from human development know the problems, often insurmountable, encountered in doing so. I would like to relate the unusual way in which a colony of a rare South California butterfly was saved.

During the summer of 1974, while engaged in my search for the presumed-extinct Atossa Fritillary (see Atala 2:2), I had the opportunity to observe the rare and local butterfly *Lycaena heteronea clara* (Clara's Blue Copper). Although the species *L. heteronea* occurs widely throughout mountainous western North America, the geographical race *clara* is limited in distribution to parts of the Tehachapi Mountains, the vicinity of Fort Tejon, and the Frazier Park area, about seventy-five miles northeast of the city of Los Angeles. Less than one dozen colonies have ever been known; at least one of these has been eradicated through human impact, in this case the construction of Interstate 5. While the butterfly may be relatively abundant where found, the size of the colony may be confined to an acre or so of suitable habitat. The larvae utilize one or more species of the widely distributed Wild Buckwheat (Polygonaceae: *Eriogonum* spp.) as their foodplant, so some other factors must limit *clara*'s distribution.

Only two prolific populations of *L. h. clara* are known to me. Both occupy montane valleys adjacent to the Los Padres National Forest. One colony lies beside a tavern. The other, very small in areal size, exploits a vacant lot in the town of Frazier Park, between buildings and an ephemeral streambed. This particular colony seemed to be the one in greatest danger of destruction by human expansion. However, while talking with some neighborhood children (and educating them about the Clara's Blue Coppers), I was told that nothing could be built on the site of the colony. This seemed a bit of extraordinary good luck to me, so I investigated the situation. It turns out that a major earthquake fault runs directly through the vacant lot. Thus, structures have been banned for a certain distance from both the fault and the streambed. It seemed I could rest assured that as long as there was a faultline, the coppers and their habitat would be safe!

Preventing the construction of buildings or facilities on high-value or tax-base land can be an incredibly difficult battle to wage, as the Xerces members working to protect the Albany (NY) Pine Bush are finding. The fortuitous presence of a geologic faultline prevented any such conflict in this case. However, the *L. h. clara* colony at Frazier Park could still succomb to overgrazing, weed-control plowing or spraying. I hope to inform the people of the village and to enlist their active cooperation in protecting their unique resource. With the help of an earthquake fault (and a little help from their friends), Clara's Blue Coppers may continue to fly.

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Corrigenda: In the previous issue of Atala (2:2) Larry Orsak's drawing of *Speyeria adiaste atossa* was mistakenly captioned "ventral." It depicts instead the butterfly's dorsum.

MARINA SAND DUNES CRISIS

by Bruce Walsh

The problems facing the sand dunes at Marina, in northern Monterey County, are typical of those which threaten all the remaining coastal dunes in California. Basically, these are overdevelopment and a proposed frontage road which would go right through the dunes. The off-road vehicles which plague many other dune systems have been banned from the Marina dunes, thanks to the efforts of many concerned citizens (including Bill Smith, a local lepidopterist). The dunes already are coming back in a velvet-green covering, now that the dune buggies and motorcycles have ceased tearing the new vegetation to bits. But the problem of the proposed frontage road has yet to be resolved. Construction could began at any time. If this road goes through, the habitat of several rare butterflies would be destroyed.

These butterflies have their strongholds in just that section of the dunes which would be bulldozed to make way for the road. The insects concerned are Smith's Blue (*Philotes enoptes smithi*) and two sympatric green hairstreaks (*Callophrys*). The Marina site hosts the last remaining dunes population of *P. e. smithi*. The once-large dune colony at Seaside-Sand City now lies under a freeway. Although a few other *smithi* populations occur in southern Monterey County (in the Big Sur - Dolan Creek vicinity) the population at Marina is unique. While the southern *smithi* colonies utilized *Eriogonum parvifolium* as larval host, this species of buckwheat does not grow at Marina. Here, the blues' caterpillars probably feed upon *E. latifolium latifolium*, as the adults associate with this plant even after it has become unsuitable as a nectar source. The proposed frontage road would destroy upward of fifty per cent of the *E. l. latifolium* plants and cut directly through the *P. e. smithi* colony.

The green hairstreaks imperiled by the road are sympatric populations of *Callophrys viridis* and and *C. dumetorum*. The colony of *C. viridis* was discovered in 1969 by Robert Langston and John Emmel. On subsequent trips Emmel found *C. dumetorum* in the same habitat. He prodeeded to carry out extensive field studies on these populations, which are unusual for their sympatry. The *C. viridis* colony is the southernmost known of a species which has suffered numerous local extinctions elsewhere in the state. Emmel discovered that the foodplant of *C. dumetorum* here is *Lotus scopairus*; that of *C. viridus*, *Eriogonum latifolium latifolium*. I found approximately 100 *C. viridis* larvae on a meter square patch of its host on 22 June, 1974. The frontage road would destroy more than fifty per cent of the *Lotus* present, and more than sixty per cent of the *Eriogonum*. What are the chances this will happen?

The road was to be begun early in 1975, but was temporarily halted by opponents including the California Native Plant Society, the Sierra Club and the Xerces Society. The State Department of Parks and Recreation, the Monterey County Regional Park Board and The Nature Conservancy are all potential buyers of the dunes for conservation. But purchase must occur soon, or the road will be put in.

(You can help California's rare blues and hairstreaks: Write the State Dept. of Parks and Recreation, 1416 9th Street, Sacramento, CA 95814, urging the saving of the Marina dunes and their rare butterflies.)

MONOCULTURE and BUTTERFLIES
BY ED GAGE

[This is the first of a new series of articles dealing with people and butterflies. Rural situations will be a frequent topic for author Gage, who wishes to "inform our readers about what to watch out for when searching for endangered ecosystems." As a farmer-scholar, Gage finds monoculture particularly intriguing and distressing.]

AS WE GO OUT TO ENJOY a part of the environment in which we live, we are faced with not one but two quite different worlds -- the natural and the managed. Most of us have a favorite place, a natural habitat still unaltered by humans. No matter where this special place may be it is characterized by its own floral and faunal elements. Temperature, moisture, soil type and many other factors combined maintain the environmental pressures which limit all organisms' ranges and numbers. Population fluctuations occur from year to year, due either to intrinsic factors or to ecological variation over time. Consequently, these favorite, natural areas may look different during succeeding visits. Still, we may look forward to the constancy of their naturalness -- at least until human pressures make an end to it.

I have spent much time in the Columbia Basin of the Pacific Northwest, working and watching. In the *Artemesia* - *Agropyron* (sagebrush - wheatgrass) habitat type of southeastern Washington, various crucifers and umbels serve as hostplants respectively for *Euchloe hyantis lotta* (the Pearly Marblewing) and *Papilio zelicaon* (the Anise Swallowtail). In recent years, this native desert has undergone drastic changes as wells have been drilled and irrigation projects developed, bringing water from the nearby Columbia and Snake Rivers. Alalfa is one of the many crops widely planted in this region of extensive monocultures; another is wheat. Monoculture, as defined by *Webster's New Twentieth Century Dictionary*, is the cultivation of a single crop or product without using the land for other purposes.

With our technology advancing toward extensive food production we adopt immaculate farming practices to meet the demand. Eventual elimination of many of our native butterflies seems inevitable in some areas as their host plants are replaced. By introducing these monocultures we change the local environment through frequent irrigation and fertilization, as well as plant selection, such that a few butterflies are favored. Some species which were previously absent or scarce in the immediate area may become hugely abundant, such as the Alfalfa Butterfly (*Colias eurytheme*) has done in southeastern Washington alfalfa monocultures.

Most species, however, diminish or disperse under an imposed regime of crop monoculture. While operating a tractor on Columbia Basin farms, I used to pass the time watching the rather spectacular Large White Skippers (*Heliopetes ericetorum*). In later years, back on a tractor again, I noticed that Large White Skippers were nowhere to be found among the extensive monocultures around Prosser. The same story applies for many other species. We will never know, for example, what wonderful assemblage of skippers and blues dwelt upon the rich glacial *loess* soils of Washington's Palouse Hills -- once a vast shortgrass prairie -- prior to the imposition of the "amber waves of grain."

Monocultures, growing as they do out of implacable pressures of population and iron economics, are hard to fight. One positive thing Xerces members can do is to survey butterfly populations in areas where change seems certain, such as big irrigation basins. In this way we will be able at least to establish insect distributions prior to local extinction. Such information will be useful for future biogeographic studies, as well as for defining baselines next to which the changes in fauna can be measured. In some instances, it may be politically possible to prevent or forestall the application of monoculture to the land; or to restore former monocultures to a semblance of their former diversity. Citizens and their advocate groups are taking a much sharper look at the Soil Conservation Service, the Bureau of Reclamation and other agencies responsible for vast agricultural alteration, and some potentially destructive projects have been stopped or reconsidered. Nonetheless, local insect poverty will probably continue to increase on the big farm. I would rather see the native species adapt, but that is seldom possible within their biological constraints.

Since we must live with the course of succession once monoculture has been instituted, we should try to plan for the retention of polyculture (including nature reserves) in at least some large land areas. Otherwise, we have have to learn to be content with fluttering splashes of sunshine as we walk along the endless miles of monocultures.

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OREGON SILVERSPOT, continued from p. 10.

Offspring thus raised will provide the larger number of specimens collectors may want. Information on rearing techniques can be obtained from the author (David V. McCorkle, Science-Math Dept., Oregon College of Education, Monmouth, OR 97361).

Digging of native plants on the Rock Creek reserve should be prohibited. The introduced Tansy Ragwort has become established here. These can probably be eliminated by hand-pulling. No herbicides should be used, of course. Generally, this plant does well only in overgrazed or otherwise disturbed areas, so it should not be much of a problem here. The native Great Tiger Moth, *Arctia caia*, has begun feeding on Tansy Ragwort at Cascade Head. In time it may play a role here as a biological control agent. Thus might another lepidopteran serve as an unknowing ally in the effort to protect the last habitat of the beautiful Hippolyta Silverspot.

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ANNOUNCEMENT: (reprinted from *Natural History*)
A LEGACY OF LEPIDOPTERA: TITIAN RAMSAY PEALE.

The original manuscripts and illustrations of *American Lepidoptera* of the 1830s and *Butterflies of North America* of the 1870s, by the American naturalist Titian Peale, will be on display in the Rare Book Room, fourth floor of The American Museum of Natural History through the fall of 1975. [Ed.note: an exquisite exhibit.

OPLER INTERVIEW (Cont. from p. 3)

collectors and watchers is greater, so that we can get the best information from the areas with the highest degree of human impact. In some of the regions where there has not been as much observation, such as the Great Basin or the Pacific Northwest, Xerces Society members could make a real contribution by providing you with faunal information before development approaches that in California. Does that make sense?

OPLER: Yes; and for some of the intermountain areas there is a likelihood of very drastic environmental changes within the next decade due to the development of energy resources. We need to know what's there before this happens.

PYLE: Have many Xerces people contributed to the Notice of Review?

OPLER: A good many have. Information published in Xerces periodicals and contributed by members has been quite helpful in putting together the list published in the Federal Register.

PYLE: But how can a member who does not happen to be conversant with his or her local fauna help? Where can they apply their tremendous enthusiasm and energy if they are not "experts?"

OPLER: One of the best ways to help is simply to belong to and support organizations such as the Xerces Society, the actions of which may be very important in moulding government policy. Other groups such as the Sierra Club, The Nature Conservancy, the National Audubon Society, the National Wildlife Federation and so on all maintain pressure for action. It is important that they do so.

PYLE: I assume that you will be anxious to hear from members who have had particular successes and problems in conservation?

OPLER: Yes I will be. As you may be aware, we do have a very heavy correspondence load which detracts from actual conservation work; so letters which require an answer without providing anything more than encouragement may not be helpful right now.

PYLE: I understand that problem very well indeed. So we should ask our readers to send you substantive letters?

OPLER: We're very happy to provide and receive information, but when it requires a letter we may lose efficiency. By all means send material of which we should be aware, however. It may often be that telephoning is faster and more efficient.

PYLE: Let's leave the clerical side of insect conservation and enter the philosophical. Suppose that the Xerces Society, the Office of Endangered Species, the Lepidopterists' Society and their allies succeed in the USA. What do you think the chances are for nature conservation in the Third World -- for example, Morphos in Brazil or Birdwings in Papua New Guinea?

OPLER: I can respond to that from two points of view. One, yes; many of the Third World countries are interested and are developing programs; and two, no; until their rates of population growth near ZPG, the prognosis for habitat conservation in the developing tropics is not very good at all.

PYLE: Coming out of Latin America as you did with extensive experience in Neotropical ecology of butterflies and other systems, would you say that you are pessimistic about wildlife conservation there?

OPLER: Yes, I'd say so. Any kinds of plants and animals associated with climax communities in the tropics, such as mature rain forest or cloud forest, will be largely extinct by the end of this century. The only remaining portions of those habitats will almost certainly exist only in a few parks and small reserves. Some people are even more pessimistic; they feel that the situation I describe will arrive in the next ten years. Some Morphos, I should add, not only occur but do well in disturbed or secondary habitats, as do many butterflies. But the climax forest endemics are in trouble.

PYLE: Many of our readers will be familiar with the theory of island biogeography as put forth by MacArthur and Wilson, and the recent output of information regarding the loss of species from islands. Of course you discuss this concept in your own paper on oaks as evolutionary islands. Do you think that vest-pocket parks and small reserves will lose species in the manner of a stabilizing island ?

OPLER: This seems clear. John Terborgh, in the December, 1974 BioScience, described this problem with respect to tropical conservation. One of the best documentations of this process is the loss of bird species on Barro Colorado Island in the Canal Zone, observed by Edwin Willis. For species which require large territories, such as the Ivory-billed Woodpecker or the Passenger Pigeon in our country, even though suitable habitat remains there may be too little of it to hold them. So if there is a reserve of the right type for Jaguars, but it happens to be smaller than Jaguar's require for territory, there soon will be no Jaguars in the reserve. Another problem with restricted areas comes from confining interspecific competition to a small arena. Normally, in an extensive habitat, species become extinct locally and then recolonize from adjacent areas. If the hinterlands are removed from the habitat picture, then there will be no source of recolonizers when these local extinctions occur. This situation is being studied for the woodland birds of eastern deciduous forests. It is clear that any forest less than, say, 2000 acres in extent will not hold all the typically resident woodland birds. So nature reserves must be substantial in size to serve the purpose for which they are intended.

PYLE: Some of our endangered butterflies, such as the El Segundo Blue, are restricted to a few acres. Can we hope that these will remain, or will they be casualties of the island extinction phenomena? Or, might there be genetic problems with inbreeding causing a loss of variability and a resulting poorer ability to adapt?

OPLER: Island-type extinctions could take place. And theoretically there is the inbreeding difficulty. For example, birds such as the Whooping Crane and the California Condor have become so reduced in numbers that inbreeding could become a serious problem. But butterflies may require less space than birds. In the case of

very localized endemic butterflies such as Lange's Metalmark or the Lotis Blue in California, these populations may already have existed in such small areas for many hundreds of years. So I think the prospects are that they might continue to survive, if we can preserve those habitats, at least for several hundred years. In all cases the largest possible reserve should be sought in order to minimize chances of extinction. But if five acres is all we have to work with, we'll take five acres.

PYLE: What is the chief obstacle to habitat conservation?

OPLER: The barrier often is that the habitat occurs in areas where land values are very high, such as in the case of the Oregon Silverspot, whose habitat is prime condominium land. The remaining habitat of Lange's Metalmark has been evaluated at something like $2 million, which is the same price tag on the Albany Pine Bush tract where the Karner Blue flies.

PYLE: So that's what we're up against. Paul, I'm going to ask you a few biggest, best and most questions, with the understanding that they are subjective and that your answers, or mine, may be no more than opinions. As an outstanding Lepidoptera researcher yourself, what is the most outstanding need for research? That is, if a young lepidopterist were looking for a project or a dissertation topic, and wanted to make a real contribution to conservation, what directions would you steer him or her in?

OPLER: One of the most important kinds of information needed by our office is very careful documentation of exactly where rarities now exist, used to exist or no longer exist. Autecological studies of endangered organisms can be vital to their management. We need to know what are the ecological factors in population fluctuation of rare butterflies -- what are their foodplants, for example. There may even be critical nectar sources. So we could potentially preserve an area with caterpillar host plants, but lacking adequate nectar resources for the adults. There are many butterflies which have widespread larval foodplants, but which occur on a much smaller area within the range of the host. Of course, one very notable example of such a phenomenon is the Hermes Copper in San Diego County. Research which elucidated the causes of range confinement could be highly applicable to conservation. So population biology, careful and rigorous life history studies and any other research which seeks to relate rare insects with their environment will be very useful in preserving such insects.

PYLE: What is most crucial politically -- land acquisition, or perhaps land use policy & law?

OPLER: A mass realization that our unique natural resources are very important to us. Just the existence of the appropriate legislation is not enough; we need the right action upon such legislation. I think it is very likely in the foreseeable future that we will have a more unified national natural resource policy, such that we can actually keep better tracks of our unique habitats and the endangered and threatened species they support. Remember, most rare butterflies occur in unique habitats which have many other, equally endangered organisms in them as well. So the best approach will be direct, physical protection of those habitats. There will always be a conflict in land use policy and it will be up to the public to decide what is most important to it: to be able to drive automobiles which help create the energy crisis, which will in turn mean strip mining of large parts of several western states and the near-total destruction of huge habitats in Colorado, Wyoming and other states, and the development of thermal energy in Nevada with similar side-effects; or whether we can switch to a less consumptive and extractive way of life.

PYLE: So the sorts of things other conservationists are worried about -- water diversion, coal and oil-shale stripping, inappropriate land development, overgrazing, overly extensive clear-cutting -- these things are the same issues which lepidopterists should worry about?

OPLER: Right. Those processes presumably are taking place through the political structure in response to public needs or wants; and as the population grows and as our energy and material needs grow, there comes an irrevocable confrontation between environmental conservation and human satisfaction. Ultimately such conflicts will have to be resolved in the courts unless public pressure and dialogue solves them first.

PYLE: These conflicts concern most of us daily, but they sometimes seem nebulous and ungraspable. In terms of real butterflies, what in your opinion is the most critically endangered species or subspecies on your list -- the one we're going to lose earliest if action isn't taken?

OPLER: The most immediately imperilled may be the Lange's Metalmark or Smith's Blue or coastal northern California, and the El Segundo Blue of coastal southern California. All three of these are restricted to very small areas, each of which is duneland facing a high probability of development in the near future.

PYLE: Beyond butterflies, which have received most of the early attention, where do you see invertebrate conservation going? We know that the mollusc people are very active. Does your office intend to deal with beetles and grasshoppers, for example, maybe even getting down to springtails and grylloblattids? Or is there a natural limit to what we can try to protect?

OPLER: The personnel in our office are obliged legally to operate under the Endangered Species Act of 1973, which includes all organisms higher than the unicellular level. In the animals this means from sponges on up, and in plants from colonial algae on up. Zeroing in on insects, we are restricted practically to working with those groups for which good distributional status and life history information is available. Lepidoptera, some groups of Coleoptera, Orthoptera and Hymenoptera are probably the ones which most frequently will meet those standards. In my own work I am attempting to concentrate on sand-dune ecosystems, which are island-like. Often an individual sand dune system will support quite an assemblage of endangered insects, not to speak of plants and possibly vertebrates.

OPLER: (Cont.) If someone petitioned us and provided us with substantial information to consider a feather mite or a flea, then we would be obliged to carry out the review process. Pragmatically, however, we have to consider how our actions may affect public opinion and, in turn, the Congress. So that, as a rule, we probably would not pursue the listing of very small mites and fleas but would limit our efforts to members of the larger arthropod orders.

PYLE: Most noxious insects, such as black flies or house roaches, are either introduced or abundant. But if you became aware of a rare one, would it be difficult to make a case for it?

OPLER: Actually, the members of Congress who put together the ESA were cognizant of that paradox and there is an exception in the law for species of insects determined by the Secretary of the Interior to be harmful to humans. Presumably they were thinking of the possibility of the Act blocking the elimination of such insects as the Boll Weevil, although most entomologists would consider such pest extirpations unlikely.

PYLE: So if entomologists reduced the Gypsy Moth to a manageable level and then actually began to exterminate it, Congress would be unhappy if you tried to bolster its numbers again.

OPLER: No doubt.

PYLE: Seriously, the document under which you work seems to be pretty flexible and to cover most contingencies. Is it effective also?

OPLER: Yes. The Endangered Species Act may be potentially the most powerful piece of environmental legislation ever enacted in the US. I think it is very important for us to get it into action, but also to use it wisely, for if we do not we are liable to have the stronger points of the Act amended out by Congress, or even to lose the law altogether. Used intelligently, the ESA can be an extremely powerful tool. It calls for close cooperation among federal agencies, and it can prevent the expenditure of federal funds on any project which adversely affects endangered species. Of course, individuals can be prevented from damaging vital habitats if it can be shown that endangered species will be killed by their action.

PYLE: If it were shown clearly that the Apache Fritillary would become extinct or close to it due to Owens Valley water diversion, do you think that that kind of money and power and vested interest could actually be frustrated by a butterfly?

OPLER: I don't know. I do know that the city of Los Angeles, in its environmental assessment with regard to water utilization in the Owens Valley, has considered the Apache Silverspot and has sought information from our office on the distribution and occurrence of this butterfly. I believe that they would make every effort to insure that at least the Round Valley population of _Speyeria nokomis apacheana_ were not heavily impacted by the water needs of Los Angeles. So they seem to be taking the law seriously.

PYLE: Your efforts and your office's press releases, together with the activities of the Xerces Society, have elicited tremendous national interest in butterfly conservation. The _New York Times_, the _LA Times_ and I think half the newspapers in between have carried stories on what once was regarded as a very esoteric subject, the conservation of rare butterflies. Do you think public interest in our field has peaked, or will it continue to rise?

OPLER: That's hard to say. Certainly there is a great deal of novelty associated with the federal government considering butterflies for the first time. I would imagine that public interest and press coverage may decline somewhat; but they will be back as soon as the situation arises wherein there is a real confrontation between a rare butterfly and a development. And this helps. In the case of the Karner Blue, I might mention that a great deal of the impact on the public conscience is due to the fine editorial writing of Lois Utley in the _Knickerbocker News_. She has had contact with Bob Dirig and has translated the situation into newspaper coverage in an excellent way.

PYLE: The press reaction has brought many concerned citizens to us for more information; quite a few have joined the Society. It seems that people are beginning to care about butterflies here, as they do in Great Britain. Would you agree that the public is taking butterflies seriously?

OPLER: Yes, very much...whether they want to or not.

PYLE: It seems there is a real and ongoing need for communication, to interpret insects to people.

OPLER: That's true. Because in many cases perhaps butterflies may suffer from errors of omission -- as when we do not relate the information in our possession to people who have impact on butterfly populations and habitats. So it is very important for us to maintain close communication with all the land-holding agencies. Even the Army is very concerned about endangered insects on land under its jurisdiction.

PYLE: One of our major goals is the provision of positive public insect awareness. Do you see this as a high priority?

OPLER: Awareness should be cultivated particularly with children at a very early age. Such groups as Boy and Girl Scouts, 4-H, and Ranger Rick Nature Club can have a great impact on the opinions of young people. As we know, once people grow to our advanced ages they are less likely to have their opinions changed. They may become aware, but not so easily as children. Insect appreciation comes easily to kids if they are not taught to hate them.

PYLE: Most people who end up in the Xerces Society, the Lepidopterists' Society, even the Teen International Entomology Group, are sort of "that way" already. If we can reach other segments of society, then I feel we will have accomplished something. Do you agree, Paul?

OPLER: Yes, I do indeed. Knowledge is a wonderful thing, but it doesn't really mean anything unless it's communicated.

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OUT OF ORDER

*INSECTS OTHER THAN BUTTERFLIES AND MOTHS are very much on the agenda of the Xerces Society. In fact, our organization's range of interest includes all beneficial or benign terrestrial arthropods. This new column, intended to be a regular feature in Atala, deals with rare populations of insects outside the order Lepidoptera. Insects comprise more than half of all living organisms. Their ecological, scientific and esthetic importance is phenomenal. Yet we know all too little about threats to insect populations and habitats. So that we can begin to circulate, think about and act upon what is known, please contribute any information relevant to OUT OF ORDER. While the emphasis of Atala (and that of XS) will remain with butterflies and moths, we hope to report something new about conserving other insects in every number.

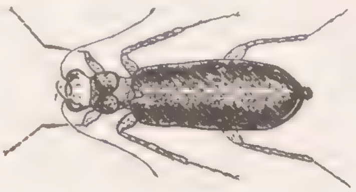
IS BROOD XI OF THE PERIODICAL CICADA EXTINCT?

Among the most amazing of insect life cycles is that of the Periodical Cicada. Commonly known as the Seventeen-year Locust, this homopteran is no locust but it does spend fully seventeen years completing its development. This makes it the longest-lived insect. But, ironically, the species as a whole (or at least major colonies of it) may not live so very long. Already there is evidence (J.A. Manter, Conn. Ent. Soc. Memoirs 1974: 99-100) that one year's brood of this insect seems to be extinct.

The Periodical Cicada occurs in staggered "broods" such that just one "brood" flies in any one year of the seventeen-year cycle. It has become customary to refer to these appearances as "Broods I-XVII." Brood I last showed itself in 1963. The nymphs borne of the 1963 adults will have dwelt underground for seventeen years prior to emerging as adult cicadas in 1979. Each brood occurs only in certain, limited areas. Thus entire annual flights are subject to extinction due to changes in their habitat or in the climate.

Manter suggests that this fate has already befallen Brood XI. In the nineteenth century, Brood XI was known from Massachussetts, Rhode Island and Connecticut. The flights of 1869, 1886 and 1903 were prolific, but numbers were reduced in 1920. By 1937, entomologists were asking whether the brood might be extinct. Manter located cicadas in Willington, Connecticut, that year and quelled anxiety for another seventeen years. In 1954, however, he found it "probable that the colony was verging on extinction." Finally, in 1971, even the Willington site produced no adults; nor were any seen elsewhere.

What caused this apparent extinction? Manter extends no hypothesis and notes no habitat changes except that "there had been no pasturing of cattle for many years." Habitat observations from former Brood XI colony sites give no further clues. But whatever the reason, the evidence indicates (as Manter concludes) "that the Periodical Cicada Brood XI has paid its last visit for us to observe." Let us hope that none of the other broods follow it. One down, sixteen to go.



TIGER BEETLES ENDANGERED BY DUNE BUGGIES & DAMS

Few beetles command as much attention from coleopterists and other insect watchers as tiger beetles (Cicindelidae). So popular are these sand-skipping gems that an entire journal has been devoted to them. That so much of its page space has been given over to conservation articles is indicative of the many threats facing these animals. Often brightly colored with hues of green, blue, bronze and creamy white, the tigers occupy tenuous habitats which are subjected to many modern pressures. Because of their proclivity for sandy spots, cicindelids inhabit such places as ocean and river shorelines, deserts and sand dunes. Perhaps no general habitat comes under more assault these days, a fact demonstrated by the many endangered butterflies of dunelands.

Wilson (1970; Cicindela 2:18-20) records that C. dorsalis dorsalis once occurred in "swarms" along the Atlantic seacoast from Martha's Vineyard south to New Jersey, whereas now it is seldom encountered. Housing developments, disturbance of larval habitat by dune buggies and oil slicks are implicated. "If [oil spills] occurred at certain critical times of the year," writes Wilson, "it could eradicate an entire population." Offshore oil drilling in Maine threatens two other tiger beetles as well, according to Wilson -- C. limbalis spreta and C. repanda novascotiae. In 1972, Stamatov (Cicindela 4: 78) elaborates on the plight of C. d. dorsalis. Documenting the recency of its rarity, he contends that the chief cause is the increasing vehicular traffic on beaches over the last twenty years. "Surf fishermen's jeeps and commercial seiners' trucks leave ruts four-to-six inches deep over the area of the beach in which the larvae formerly lived."

In the West, dams pose further problems. Cutler (1970; Cicindela 2:10) expresses fear for populations of rare cicindelids and other insects (including the Dakota Skipper) if the Sheyenne River is dammed in North Dakota. Dams on the Columbia and Snake Rivers in Oregon and Washington have already caused the extermination of the Northwest endemic C. columbica from much of its range (Beer, 1971; Cicindela 3: 32). The popular tiger beetles seem, somehow, not to deserve so many perils.

ON THE WING

Butterfly Conservation Status Reports

Ever since A.R. Grote expressed concern for the future of the White Mountain Butterfly (Oeneis melissa semidea) in the Presidential Range of New Hampshire's White Mountains, entomologists have been watching out for it. Now, more than a century since Grote, several Xerces Society members are working with the New Hampshire Entomological Society and the Mt. Washington Commission to protect populations of O. m. semidea and Boloria titania montinus from effects of summit facility construction. Chief Counsellor IVY LE MON has stimulated much letter-writing by concerned individuals, leading to assurances by officials that the butterflies will not be overlooked by planners. A full report will follow in a future number of Atala. Meanwhile, according to IVY, lack of funding has blocked construction for now.

Standard Oil Company has been approached by XS Executive Board Member JEANNINE OPPEWALL about its willingness to protect the El Segundo Blue (Philotes battoides ssp.) population on its California dunes. According to JEANNINE, the corporation representative seemed interested and receptive.

Elsewhere in the Southwest, GREGORY FORBES is documenting the destruction of butterfly-rich desert riparian areas by agriculture. He writes that pumping of groundwater, clearing of land, river channelization, bank burning and spraying and dams have exerted profound depreciative pressures upon insect habitats. For just one example, GREG notes that Limenitis archippus obsoleta has virtually disappeared from Blythe, California, on the Colorado River -- the same place where Comstock found the butterfly plentiful and worked out its life history. L. a. obsoleta, a Viceroy, is among the butterflies listed by Paul Opler of OES as possibly endangered. FORBES reports numerous other riparian losses in California, Arizona and New Mexico. He is working to determine those areas which might be conserved.

In Antioch, California, a one-year moratorium has been imposed against development of the small tract of dunes which comprise Apodemia mormo langei (Lange's Metalmark)'s sole habitat. This ruling came in response to testimony by XS Chief Counsellor JERRY POWELL and others. After the year has passed, however, potential industrial development of the dunes will be reconsidered.

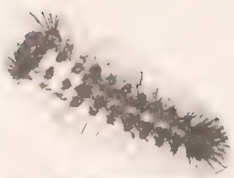
Some Striking Successes...

The United States Forest Service scores high in butterfly conservation this spring. First, the Cibolla National Forest released its Final Environmental Statement and Land Use Plan for the Sandia Mountains in New Mexico. Since this range is the type locality and a stronghold of the rather recently discovered Sandia Hairstreak (Callophrys [Sandia] macfarlandi), the Xerces Society provided input to the Forest Supervisor W.L. LLOYD, who showed a continuing interest. This was, in fact, the first issue upon which the Society acted following its formation in 1971. We were delighted to see that the EIS and Plan alot more space to the Sandia Hairstreak than to any other animal on the Forest! The insect is pictured twice, its biology is discussed and R.M. PYLE's testimony is reproduced in full. The impact of proposed plans in each management unit of the Sandias upon C. macfarlandi receives treatment in the text. The areas of densest concentration of the foodplant, Beargrass (Nolina microcarpa), will be managed to conserve the plant and the butterfly. While the Sandia Hairstreak is not an endangered species, it does fly in a limited area of the Southwest and could be at least locally affected by major land use changes. In all, this represents the fullest demonstration of federal agency concern for butterfly conservation yet, with the exception of OES. Second, as reported earlier in this number, a portion of the Siuslaw National Forest in Oregon will be dedicated as a reserve for the Oregon Silverspot (Speyeria zerene hippolyta) on June 22. This will come about largely due to the efforts of XS C.C. DAVID McCORKLE.

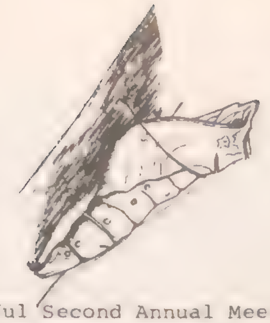
Another Chief Counsellor of the Society, WILLIAM E. SIEKER, has "some very good news for lepidopterists," which I quote: "The Wisconsin Chapter of The Nature Conservancy, of which I am state counsel and board director, has acquired from the Wisconsin Power and Light Company a piece of land along the Wisconsin River called Ferry Bluff. This is the best spot for Catocala species in Wisconsin and certainly one of the best in the country, if not the best small area for these interesting, beautiful insects. We get the Amorpha feeders at this spot, such as C. amestris, C. nuptialis and C. abbreviatella. All of these are very rare...This is an interesting place for other moths and butterflies too. I have taken Mitoura gryneus there many years ago, and this is a much sought-after butterfly in Wisconsin. This land will be managed by the Head Foundation with help from the University of Wisconsin." BILL sends his regards to the Society. Certainly he deserves our collective appreciation for his role in this great success.

Just as it is good to hear of fine land conserved, so is it heartening to learn of the "rediscovery" of presumed or possibly extinct organisms. Hence, DALE SCHWEITZER's manuscript on Catocala pretiosa, which appears earlier in this issue, was received with pleasure. Readers will remember from Atala 2(2) that LARRY ORSAK set out to search for the "lost" Atossa Fritillary. Recently, LARRY conveyed the good news of his success at ascertaining the healthy existence of another rarity. Visiting Santa Catalina Island, California this April he located fair numbers of the Catalina Orange-tip (Anthocharis cethura catalina), which has not frequently been reported in recent years. ORSAK concluded that "the butterfly has managed for years to survive the onslaught of the environment by goats and wild boars and it is doubtful that it will succomb to any foreseeable habitat changes (such as fire) short of commercial development." On the same expedition, LARRY verified the prolific existence of the two other island endemics on Catalina -- the Avalon Hairstreak (Strymon avalona) and Gunder's Orange-tip (Anthocharis sara gunderi).

Finally, wonderful news comes from JORGE KESSELRING that the famous Morpho forest at Tiúma, Brazil, has been saved from clearing in the eleventh hour. A full report will follow in the next issue of Atala.



METAMORPHOSES



ELECTIONS: Thirty-two XS members and guests registered for the highly successful Second Annual Meeting of the Xerces Society at Cornell University, April 25-27. The gathering, which will be reported fully in the next issue of Wings, was organized superbly by JOHN CRYAN and ROBERT DIRIG, with the aid of DAVID SHAW as Registrar. By-Laws and Articles of Organization were adopted at last (and will be made available soon), providing for the first election. Chief Counsellors and Honorary Counsellors remain appointive. Nine positions on the new Executive Board were filled. Elected to one-year terms (eligible for re-election to full three-year terms) were FRANCIE SZE-LING CHEW, JOHN CRYAN & TOM FRANKS; to two-year terms, CHARLES COVELL, JR., LARRY J. ORSAK & RAY STANFORD; and to three-year terms, ROBERT DIRIG, JEANNINE OPPEWALL & WILLIAM (DAVE) WINTER. Other officers elected, all for three-year terms, were ROGER PASQUIER, TREASURER; JOAN DE WIND, SECRETARY; JO BREWER, ASSOCIATE DIRECTOR; & BOB PYLE, DIRECTOR. Meanwhile, across the Atlantic, XS member MICHAEL G. MORRIS has been elected President of the British Entomological and Natural History Society. One more major office occupied by a member of our Society is the Presidency of the Equilibrium Foundation, held by CHARLES L. REMINGTON. Two other Chief Counsellors, F. MARTIN BROWN and WILLIAM E. SIEKER, are serving postions of regional leadership in The Nature Conservancy this year.

HONORS: At the Annual Banquet of the Society, held in Ithaca, NY on April 26, a special citation was awarded ROBERT DIRIG for his tenacious and sustained efforts on behalf of saving the Karner Pine Bush, increasing public insect awareness and advancing the aims of the Xerces Society. It was agreed unanimously that his endeavors in the field of Lepidoptera conservation have constituted one of the truly outstanding personal contributions to the movement. As a small token of recognition, a gift certificate to Entomological Reprint Specialists accompanied the citation. One of our most distinguished members, ROGER TORY PETERSON, found time to attend the Xerces meeting "just because I was interested." He had just returned from birding in Bhutan, where a tortoiseshell butterfly alighted on his shoulder at a lofty altitude. Following the XS meeting he flew to England, where the former Audubon medalist received the latest in a long string of awards: Honorary Fellowship in the Zoological Society of London, a distinction held by only twelve persons and only one other American.

JOBS & GRANTS: TERRY L. CHESTER, who wrote about mantids in the previous number of Atala, has been selected as a Fulbright-Hays Scholar to Nigeria for 1975-76. Having just completed his MS. at the Yale School of Forestry and Environmental Studies, TERRY will be conducting research on the Western Toad at the Rocky Mountain Biological Laboratory this summer. First, however, he and XS member MEREDITH MUNSEY will be married in the Connecticut woods on June 1. In Africa, TERRY will investigate mantid ecology. FRANCIE CHEW, this issue's cover artist and an XS Executive Board member, has accepted a position in the Department of Biology at Tufts University. She completed her PhD on *Pieris* butterflies at Yale University last year, working under Professor C.L. Remington.

IN THE MEDIA: Following a time-honored British custom of butterfly letters in the London Times, R.M. PYLE submitted a letter-to-the-editor of the New York Times on the subject of insect conservation. This was published January 9, followed by a March 21 article about Paul Opler and the OES Notice of Review of potentially endangered butterflies. Since then the XS Director has been interviewed by the Los Angeles Times. Articles in the LA Times, the NY Times and about half the papers in between have resulted in tremendously increased interest in the Xerces Society and its goals. Television too has exploited the novel idea of saving butterflies. C.L. REMINGTON discussed New Haven's West Rock and its special butterflies on an East Coast program, while JO BREWER AND R.M. PYLE put on a live presentation about the Xerces Society on Boston's Catch 44, and DAVE McCORKLE publicized the Oregon Silverspot on TV in that state.

CHARLIE COVELL: One of our most prolific activists, CHARLIE warrants his own category. Both a Chief Counsellor and Executive Board Member of XS, he embarked on Phase IV of Project Ponceanus in Florida shortly after making a primary contribution at the Cornell meeting. In addition to pursuing the awesome task of writing the Peterson Field Guide to eastern moths, CHARLIE recently founded the Society of Kentucky Lepidopterists. Recently he was heard to say that he would not care to hold an office if it meant doing nothing. We can believe it.

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PASSINGS: Again this issue we have the sad duty to report the deaths of two fine lepidopterists and conservationists, both members of our Society. Shortly after Christmas we received word that ENID CAMPBELL had died. ENID played a prominent role in the day-to-day conservation and habitat management of the rare Heath Fritillary (*Melitaea athalia*) in England. She served as voluntary warden of the major reserve for this butterfly on behalf of the Cornwall Naturalists' Trust. With her husband ALAN, ENID dwelled on a lovely and successful Cornish farm, where the Editor found warmth and hospitality more than once. A daughter of the rich British butterfly tradition, she carried on its loving care of the countryside. Late winter also saw the passing of P. SHELDON REMINGTON, at the time the newest member of the Society. The father of C.L. REMINGTON had long been active in the Lepidopterists' Society, in whose journal he published frequently about skippers and other interests. An advanced orchid enthusiast, the elder REMINGTON was Headmaster at a Greenwich, Connecticut private school at the time of his death. Another very active amateur lepidopterist, MICHAEL DOUDOROFF, died in Oakland, California recently. A biologist who took part in the first synthesis of sugar, he was also namesake of the endangered butterfly *Callophrys mossi doudoroffi*. The preservation of Doudoroff's Hairstreak would be a fitting memorial to its discoverer.

For more than two years, the Xerces Society has actively solicited and synthesized information on insect collecting as a possible conservation concern. A large body of material came together into the fattest folder in our files, a rather bizarre situation since habitat conservation is by far our greatest concern. The results of our study fill some fifty pages, condensed. Clearly, the entire report cannot be circulated among the membership. But our files are open, and a manuscript is in preparation which will analyze the situation in depth, in another journal. From the start, it was obvious that opinions of members vary widely. A striking need emerged to reconcile pro-collecting and anti-collecting viewpoints in the Society, in order to prevent a major ideological schism which would rob conservation of valuable energy. It is our conclusion that, given tolerance, such a reconciliation is entirely possible and should be pursued vigorously. Toward that end a proposed policy has been drafted. Here are some of the chief points upon which it was founded, as distilled from the full study report:

a) Nearly all lepidopterists, whose expertise we urgently require, are active collectors of butterflies and moths. To take a hard line against collecting would alienate these people.

b) There seems to be no sound reason for doing so. All available evidence indicates that it is exceedingly difficult to damage a population of mobile invertebrates, such as most insects, through collecting. Given the facts of insect population biology, including their rapid replacement and vast "over-production," overcollecting of insects is a hollow threat. Only in cases of extremely weak, depleted, local and environmentally stressed populations can intensive collecting be a long-term depreciative factor.

c) Far more opinion is available than solid, rigorous data, and experimentation is needed. Xerces members' opinions vary from radically pro-collecting to radically anti-collecting. The great majority with whom I have communicated are collectors or non-collectors who are unaware of any conflict between the two.

d) There are many kinds of collecting, ranging from purely scientific through recreational and on into commerical. Numerous motives exist for collecting insects -- urges for knowledge, ownership and acquisition, exercize, appreciation of nature, order and organization, artistic expression, profit-making -- and these can be subjectively arranged along a continuum of "purity." At one end might be basic research oriented toward species conservation; in the middle, basic hobbyist collecting; and at the lower end, mass collecting of exotic butterflies for fixation in clear plastic toilet seats. I have encountered all three of these motives, and many more, in the course of this study. The point is that each person must draw the line at which point along the collecting continuum his or her sensitivities are offended. Almost everyone would accept the research collector and very few would criticize the hobbyist, while fewer yet perhaps would tolerate the toilet-seater. Since this judgement is so very subjective, according to personal taste and philosophy, it should be left to the realm of personal decision: UNLESS populations are actually threatened by collecting; that is where the Xerces Society draws its line.

e) Insect collecting, intelligently done, can yield real benefits to society. Among these are knowledge upon which sound land-use decisions can be made; a great deal of pleasure for individuals; attraction of youths to natural history studies (most biologists began as collectors); and economic benefits.

f) In an animal-exploitative society, it seems untenable for a group such as ours to extend and impose as set of external ethics upon its members, unless doing so preserves the public interest (which, in this case, is the conservation of insect populations). In other words, freedom should be limited only as the common good requires.

In order to make our position clear, protect populations where necessary and bring together all of our members under a sound agreement, I have drawn up a PROPOSED policy for the Society on collecting. At the Cornell meeting the sense of the floor supported this draft overwhelmingly. However, it is the belief of the Directors that such an important policy should be ratified by referendum vote of the membership. If you care, please send your approval or disapproval of this policy, plus any comments, to the Director prior to October 1, 1975: Robert Michael Pyle, Yale School of Forestry and Environmental Studies, New Haven, CT 06511. A simple majority of those voting will carry the referendum.

* *

XERCES SOCIETY POLICY ON COLLECTING

1) This is the express policy of the Xerces Society on the matter of insect collecting. It pertains ONLY to terrestrial arthropods and should not be assumed applicable to molluscs, marine organisms or vertebrates.

2) Only that collecting is opposed which may seriously be considered to threaten or endanger a population. Species classified as endangered under the Endangered Species Act or its international equivalents should be collected only with sound cause and valid permit.

3) All collectors should use care and restraint with rare, very local, weak, depleted or environmentally stressed populations. That is, collectors should evaluate the possible consequences before collecting. Also, they should not take specimens which are the immediate objects of other peoples' appreciation.

4) Collectors should avoid excessive damage to habitats from their field work and should not uproot quantities of scarce larval foodplants.

5) Collectors should make their knowledge available and their collections accessable for research.

6) Commercial trade in insects is neither supported nor opposed, except that the welfare of populations must come first in assessing harvest. In the Third World, insect-derived income should go to indigenous people rather than to expatriate marketeers.

7) The Xerces Society will endeavor to identify and protect those few populations to which overcollecting may represent a risk. Conversely, the Society will oppose legislation and regulations which unnecessarily restrict collecting, thus drawing attention away from habitat conservation. Collecting should not be a scapegoat for more serious threats of habitat alteration.

8) Members of the Xerces Society are free to form their own attitudes regarding different kinds of collecting and they should respect that freedom in others.

These people contributed their talents to Atala, Volume 3 Number 1:

Francie Sze-Ling Chew, the cover artist, has studied butterfly biology at Stanford and Yale. She will assume a teaching & research post in the biology department at Tufts University this autumn.

Jerzy Dabrowski illustrated and wrote our article on Polish Lepidoptera conservation. Born in Kraków in 1936, he received his Doctorate in biology at Jagiellonian University and now works at the Forest Research Institute. American lepidopterists are familiar with his many fine publications.

Scott Ellis, a professional environmental consultant in Colorado, is a Chief Counsellor of the Xerces Society. An adventurous field naturalist, he co-discovered the S. nokomis colony of which he writes.

Ed Gage, the author of our new column, began studying butterflies at age five -- and kept on, taking a Masters' degree in entomology at Arkansas twenty years later. A student of Northwest Lepidoptera, Ed found five Limenitis lorquiniXarchippus hybrids in Washington in a short period. Now a County Agent for the University of Idaho, he continues his investigations of butterflies and their conservation.

Quimby F. Hess holds the position of Environmental Quality Coordinator in the Ontario Ministry of Natural Resources. As a forester and lepidopterist, he recognized the need to protect P. virginiensis.

David McCorkle pioneered butterfly conservation in the Pacific Northwest by convincing The Nature Conservancy to set aside the Moxee Bog, one of Boloria selene's few habitats in Washington. An extremely prolific researcher, Dave finds special attraction in forest Mitouras as well as seaside Speyeria.

Larry Orsak conducted Project Atossa under the Xerces Society's first research grant. Readers will find his name associated with a surprising number of additional issues in this number of Atala. The energetic Orsak, Endangered Species Coordinatior for XS, will begin doctoral studies in entomology this autumn.

Noble Proctor, a name associated with birds all over New England, is rapidly coming to mean butterflies as well. The Connecticut ornithologist and Audubon tour leader enjoys an immense natural history repertoire. His keen curiosity and birder's eye are finding new insect phenomena each season.

Sally Pyle wrote the Self-Help Sheet about the Xerces Society Fourth of July Butterfly Count (mailed separately, first class) after she originated the idea. A former cover artist, her illustrations appear on the back cover and elsewhere in this issue (the name under which she draws is Sarah Anne Hughes). Sally received her degree in plant science from the University of Bath, England; her specialty is museums.

Dale Schweitzer, while completing his PhD on lithophanine moths from the University of Massachussetts, is Assistant Curator of Entomology at Yale's Peabody Museum of Natural History.

Jennifer Slade found an interest in insects during her graduate studies at the Yale School of Forestry and Environmental Studies. A research trip to Isle Royale National Park gave her the chance to indulge that enthusiasm, as well as an appreciation of unspoiled wild country as butterfly and moth habitat.

Bruce Walsh came to the Lepidopterists' Society in Los Angeles last year and told us terrible tales of habitat destruction in the Carmel Valley. As his article shows, he is doing something about it.

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Publications

A superb new publication is Xerces member Robert Dirig's Growing Moths (4-H Members' Guide M-6-6). Lavishly illustrated with the author's fine drawings, those of John Cryan and others and photographs, the book carries a magnificent color Luna Moth on its cover. Never, perhaps, has so much excellent information on the rearing and enjoying of moths been brought together before. All Lep. lovers will want to send $1.50 to the Mailing Room, Bldg. 7, Research Park, Cornell U., Ithaca, NY 14853, for this.

Adding to this bonanza of insect interpretation are Alice Gray's very fine Insect Study Direction Leaflets, which have been reprinted. This editor used these Leaflets with great pleasure and satisfaction for many years. Miss Gray, another Xerces member, thrilled everyone at the recent Society meeting with her fabulous insect education talk, replete with tarantula and scorpion. She thought it would only work with kids! The rest of her career is booked up by New York City schools. You can get a taste of her expertise from the Leaflets, available from the American Museum of Natural History.

Jo Brewer's amazing Alphabet Coloring Book for Limerick-Loving Lepidopterists can still be ordered by sending $3. to Jo Brewer, address inside front cover. See full announcement with Self-Help Sheet #3. All profits from this limited-edition volume will go to butterfly conservation. Do get yours!

Mr. Wallace P. Murdoch, Executive Secretary of the Entomological Society of America, has asked us to announce that ESA has available Bernard D'Abrera's Butterflies of the Australian Region. Illustrated with more than 2300 excellent color photographs, including all of the threatened giant birdwings of Papua New Guinea, the book may be ordered for $29.95 from ESA, 4603 Calvert Rd, College Park, MD 20740.

Recent issues of Natural History magazine have carried Lepidoptera articles by Xerces Society members. Heliconius butterflies featured in the February, 1975 issue, and Cynthia Moths in the May number, in articles written respectively by J.R.G. Turner and R.M. Pyle.

The current Journal of the Lepidopterists' Society contains no less than four papers dealing in part with rare and endangered butterflies. Xerces members should consider joining the Lep. Soc. as well.

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"The increasing number of motorcycles, trailbikes dunebuggies and other vehicles driving over every small patch of sand may b endangering many species of tiger beetles across this country."
--John Stamatov

Cicindela dorsalis, an endangered tiger beetle

ATALA

Volume 3
Number 2.

Fall - Winter
1975

COVER CREATURES: [illegible] BLUE BUTTERFLIES

* *

[illegible] the Mission Blue and the Lotis Blue all have in common? Of course, they share [illegible]

The Karner Blue, believed by Vladimir Nabokov (who described it) to be a dis- [illegible]

[illegible] tion of butterflies I have ever encountered -- some tens of thousands in a very [illegible] ability is not in the color, but in the specificity of the habitat . . . and in the [illegible]

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FRONT COVER: [illegible]

[illegible] by JANET GOHRES, a Xerces [illegible] lives in Cambridge, Massachusetts. [illegible]

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THE XERCES SOCIETY

[illegible]

ATALA Volume 3, Number 2, Fall-Winter, 1975

[illegible] Ave., Albany, California 94706

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THE XERCES SOCIETY IS NOW A TAX- [illegible] favorable tax - exempt ruling from the In- [illegible] POSES. Since the programs of the group [illegible] contribution is hereby requested.

We wish to acknowledge a grant from the World Wildlife [illegible] progressive development of the organi- [illegible] and for a generous donation from Edwin [illegible] warm appreciation.

MEMBERSHIP is open to all. Please [illegible] to the Treasurer, Roger Pasquier, 235 E. 73rd St., New York, NY 10021. Members receive Atala twice yearly.

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Published at New Haven, CT., twice yearly. Date of publication 27 January 1976.

printed by Dwight Hall Press

THE SAVING OF THE EL SEGUNDO BLUE

Jeanine C. Oppewall
1021 C. 20th St., Santa Monica, CA 90403

In August, 1975, Standard Oil of California constructed a chain-link, barbed wire-topped fence around approximately two acres of its land which comprise a habitat for the El Segundo Blue butterfly (Shijimiaeoides (Philotes) battoides allyni Shields). The fence, and the policy decision behind it, amount to the first formal butterfly reserve in California.

The butterfly and its habitat. The beneficiary of the fence, the El Segundo Blue, is a member of a group of small blue butterflies whose life cycles are always very closely associated with a particular group of foodplants. These hosts belong to the genus Eriogonum in the buckwheat family (Polygonaceae). The blues which feed on them have long been generally known by the genus name Philotes; but a recent revision of the group by Oakley Shields (1975) has placed the species battoides and its near relatives in the genus Shijimiaeoides.

For the past 25 years Southern California lepidopterists interested in the Philotes-like blues have recognized these features which distinguish the El Segundo Blue from other populations of S. battoides: heavy, squarish spots on the underside of the wings in both sexes, and a narrow, light orange aurora on the upper side of the hind wings of males.

All Shijimiaeoides larvae eat the flowers of Eriognonum and pupate in the sand at the base of their foodplants. Adults emerge once a year, when the plants bloom, and nectar exclusively on their flowers. Females oviposit on the flower buds. Shijimiaeoides butterflies and Eriogonum plants seem to exhibit co-evolution: in many cases, one species of buckwheat supports a single species of blue.

The foodplant of the El Segundo Blue, Eriogonum parvifolium parvifolium Sm., occurs only along the immediate coast of a few Southern California counties. It is a characteristic member of a habitat association known as coastal strand and dunes -- a community subject to a fairly even year-round climate, frequent fogs, low rainfall, relatively high humidity and substantial wind. The wind creates constantly shifting sand dunes, which bound the habitat on its oceanward side. Behind this first row of dunes, which functions as a kind of windbreak, larger, more stable dunes with a permanent plant-cover can form. Such native plant colonizers as Eriogonum parvifolium help to stabilize the dunes, which would otherwise blow inland with the prevailing winds. The indigenous flora and fauna of these dunes include the White-leafed saltbush, lupine, Beach morning-glory, Sand verbena, sand roaches, dune weevils, velvet ants, wasps, crabs and the California legless lizard. "Weedy," colonizer butterflies with extensive ranges, such as the Fiery Skipper (Hylephila phyleus) and the Gray Hairstreak (Strymon melinus), can also be found here. Still farther inland, beyond the secondary row of dunes, less wind-resistant plants can grow. The coastal strand is a complex, dynamically changing system.

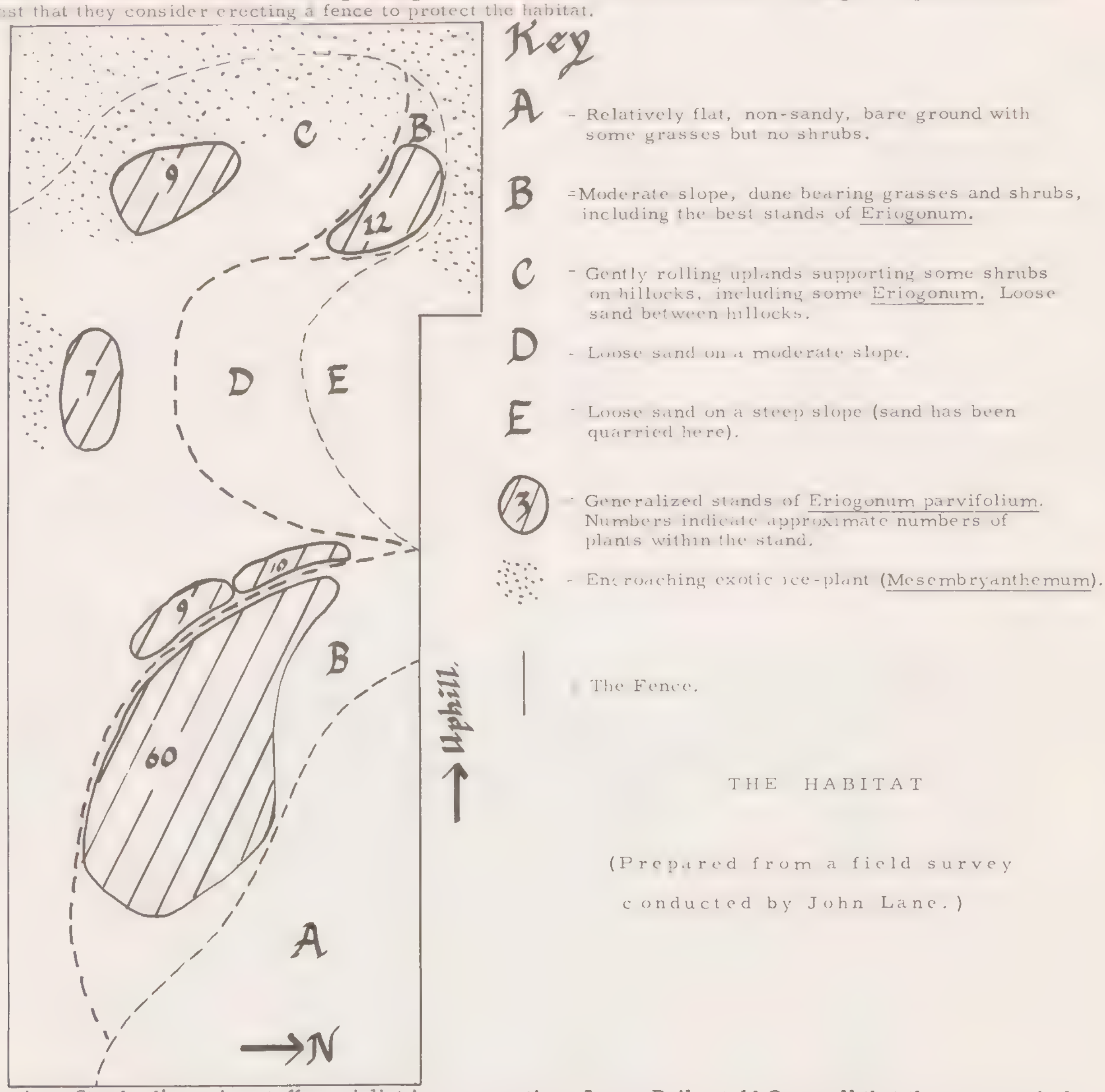
This particular system of dunes once covered about 100 square kilometers of Southern California, but is confined now to a few hectares owned by Standard Oil of California and the Los Angeles International Airport, in El Segundo. Several plant and animal species were originally described from the El Segundo dunes, so the area is an important and well known type locality, of real biological significance. But rapid, unrestrained urban growth and the recent off-road recreational vehicle mania (described by some as Californication) are bringing about the demise of this extremely fragile plant and animal community. Often where dune areas have been developed or impacted, and the native plant cover removed or disturbed, people have introduced an exotic species of ice-plant (Mesembryanthemum spp.) to hold down the sand. This ice-plant is tough, aggressive and rapidly spreading; native species cannot compete with it and are eventually choked out. The Xerces Blue, now extinct, was once a part of a similar coastal strand system.

El Segundo Blue on host-plant, J. C. Oppewall

History of the issue.

The precarious situation of the El Segundo Blue has been recognized for some time. Tom and John Emmel (1973) wrote that the butterfly "will probably become extinct unless some sort of action is taken to preserve the habitat areas." It was virtually expected that the El Segundo Blue would join its Northern Californian relative, the Xerces Blue, on the register of recently extinct North American butterflies. Then it was reviewed by the Office of Endangered Species as a possible inclusion for the Federal List of Threatened and Endangered Species; and in October, 1975, S. b. allyni was officially pro- by the Department of the Interior for listing as an Endangered Species -- along with five other butterfly taxa, all of them Californian (Greenwalt, 1975 a & b).

Efforts to secure the preservation of part of the El Segundo Blue's remaining habitat got off the ground last year, through the efforts of three California members of the Xerces Society. Dr. John Emmel learned from the Los Angeles County records Office that the habitat in question -- an undeveloped lot at the end of West El Segundo Boulevard -- belonged to Standard Oil of California. John Lane investigated and obtained the name of the corporation's local public relations officer. And Jeannine Oppewall agreed to approach the company. The plan was, first, to alert Standard to the existence of the El Segundo Blue on its property and to acquaint them with the uniqueness of its habitat; second, to advise the company that the United States Department of the Interior was considering adding the creature to the Threatened and Endangered Species List; and third, to suggest that they consider erecting a fence to protect the habitat.



THE HABITAT

(Prepared from a field survey conducted by John Lane.)

At the first meeting, Standard's senior staff specialist in conservation, James Daily, told Oppewall that the company had no immediate plans for the parcel of land. He added that he appreciated being informed of the butterfly's existence, and noted that environmentalists have a habit of keeping such information to themselves until the company, unaware, is well down the road toward executing a plan which environmentalists consider unacceptable. To help support the presentation, a booklet containing photographs of the butterfly and its habitat, some descriptive information about the El Segundo dunes ecosystem and a few specimens were taken to the initial meeting. Both the booklet and the specimens were left with Standard executives so that they could continue to refer to these materials during their own, subsequent meetings.

Dr. Paul A. Opler, staff specialist in entomology in the Office of Endangered Species, Fish and Wildlife Service, USDI, submitted a follow-up letter to Standard, advising the company that "... any actions that can be taken by local groups, private landowners, local governmental organizations, or others who can insure the continued survival of endemic species, such as those occurring on remnants of the El Segundo dunes, should be applauded and supported. Any such action might well be more favorable to the continued existence of these species than any potential listing." Within a few weeks of the initial approach, the company had formulated and approved plans for the construction of a fence; furthermore, they had agreed to clean up miscellaneous debris in the area, and to remove the aggressive ice-plant from the bottom of the hill. And in August, 1975, the fence was erected.

Lepidopterists investigate the site (l. to r., J. P. Donahue, P. A. Opler, J. A. Powell), J. C. Oppewall.

While the fence was going up, The Nature Conservancy approached Standard Oil and offered to take over ownership of the site, thus relieving the company of the management burdens "in perpetuity" and conferring some tax benefits for Standard. But Standard, itself a long-time member of TNC, politely declined, indicating that it could use this land for many purposes compatible with the continued existence of the butterfly population.

At the moment, one of these compatible purposes involves a plan to construct a refinery radio tower in the southwest corner of the tract. "This will in no way, either during construction or operation, disturb the natural habitat," says a company spokesman. A number of weeks prior to the installation of the fence, the Los Angeles County Flood Control Project constructed a tunnel to the Pacific Ocean running 100 feet beneath the habitat. Standard officials were able to make it clear to the flood control engineers that the surface was not to be disturbed, and they complied. The proximity of the oil storage tanks to the habitat is somewhat worrisome: the ground on the side of the property nearest the tanks is already visibly oil-soaked. Ice-plant still claims some of the terrain on the southwest side of the lot. And corporate policy, now friendly toward butterfly conservation, could conceivably change. Clearly, intelligent and vigilent management of this miniscule seaside habitat will continue to be absolutely necessary.

The largest remaining portion of the El Segundo dune ecosystem occurs to the north of the Standard Oil refinery, on land located at the oceanside end of the Los Angeles International Airport runway complex. The Airport Commission has, over the last few years, been buying property in this area and demolishing buildings thereon. Airplane noise rendered the area undesirable for housing. But recently, in an effort to recover some of the money spent on this property, the airport authorities have been proposing development of the area for recreational use as a golf course.

The Airport Cities Action Committee recently informed Julian Donahue, Assistant Curator of Entomology at the Los Angeles County Museum of Natural History, of these preliminary plans. Donahue alerted the Office of Endangered Species. In turn, OES wrote to the California Coastal Zone Conservation Commission, informing them that "if such a development were to take place, it would result in the virtual extinction of a number of unique species and the destruction of an entire, unique ecosystem." To secure the preservation of the airport dunes is clearly the next task.

A few observations. A substantial amount of publicity has been generated by the creation of the Standard Oil butterfly reserve. Several local newspapers, as well as the Los Angeles Times, the Los Angeles Herald Examiner and the Christian Science Monitor have carried stories about the butterfly and the fence built to protect it. All the reaction, so far, has been positive. However, before congratulating ourselves, it might be a good idea to try to determine those elements which made the creation of this particular reserve possible; and to see which, if any, of those elements can be isolated, characterized and applied again toward future efforts at habitat conservation. In a way, one is hunting for an algorithm -- a set of ways to begin to attack the same sort of problem someplace else.

A number of unique factors helped to make the creation of this preserve possible. The land lies immediately adjacent to Standard's oil tanks and refinery and so has less-than-optimal desirability as a site for housing or recreation. Public respect for powerful oil corporations such as Standard of California has reached a low point, and large corporations whose public images are in trouble watch out for opportunities to publicize instances in which they have behaved with generosity and responsibility. A corporation, like an individual, possesses a strong instinct for self-preservation; it can be counted upon to act in its own best interest, to minimize its

pain and maximize its pleasure. In this light, Standard acted predictably by constructing the fence. The company seized the opportunity to enhance its community image and to improve its standing with the Department of the Interior. It had little to lose: the fence cost about $4000.00 and the only dissatisfaction has come from a few residents of the immediate neighborhood who are disgruntled because the fence deprives their children of a ready-made playground. This is not to say that Standard acted grudgingly or without genuine good will. The company has a well developed sense of public accountability and its representatives displayed real concern for the plight of the insect and its habitat. Politics is very much the business of balancing the special interests of differing individuals and groups in light of the overall needs of the community. To be realistic, in matters of political interest, such as securing the preservation of a butterfly habitat, one cannot count on the logic or good will of another special interest group with different ends in mind. All one has to go on is one's own interest and an imaginative understanding of that of others. It is a happy event when self-interest and public-spiritedness can coincide, as in the case of the El Segundo Blue and Standard Oil of California.

At the risk of over-simplification, perhaps there are a few practical and obvious elements of this case which can be selected and assembled as a potential algorithm toward the politics of preservation: 1) Nothing is gained by waiting to alert the owners of property inhabited by endangered species until they have already announced intentions unhappy for the species; by this time parties are already polarized, sides chosen and lines drawn.
2) In making a presentation to the owners, one is obliged to be coherent, cogent and unimpassioned -- and supported by as many high-quality visual aids and as much well reasoned documentary information as possible.
3) Good hunters know that their only hope for success is to familiarize themselves with the behavioral patterns of their prey. So before making an initial communication, study the habits and preferences of the organization being petitioned. Know its wounds and sensitivities, its vulnerabilities and -- most of all -- where its interests lie.

Postscript. Donahue (1975), in reporting on the endangered butterflies of the state for the Governor of California, wrote of the El Segundo Blue: "Prospects for preservation are excellent if the habitat can be preserved." For the time being, one small habitat of this animal has been set aside, protected from midnight sand requisitions, off-road recreational vehicles and other human disturbances. The general manager of Standard Oil of California, Thron Riggs, guarantees access to the habitat -- now under company padlock -- "to all qualified individuals who may wish to study this butterfly habitat." Future hazards to *S. b. allyni* are built into the reserve, such as possible loss of adaptive variability due to inbreeding in so small an area. Nevertheless, the fence does serve as a reminder that our own special interests and those of others can be made to intersect, if only on a small plot, in the real world. X

Standard refinery, blue habitat and fence. J. C. Oppewall

Acknowledgements: I would like to thank John Emmel, Julian Donahue and especially John Lane for the information and help each of them gave in the writing of this piece.

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THE SAVING OF A MORPHO FOREST

Jorge Kesselring
Rua Jose Peregrino, 159, Joao Pessoa, Paraiba, BRASIL

(Abstract: The Forest of Tiuma (São Lourenço da Mata), in the region of Pernambuco, Brasil, has been placed under federal protection due to its biological importance. Actions leading to this reservation are described, as is the ecology of the forest, particularly the Morphinae and other butterflies in which it is very rich.)

In Northeastern Brasil, not many forests remain. Most have fallen victim to the axe -- cleared for plantations, for expanding towns and cities, for highways, or simply for firewood and charcoal. Of the forests which still stand, the majority have been more or less devastated and are in constant danger of being chopped down.

Consequently, it is no longer easy for the entomologist to find suitable places for collecting and observing insects. This may come as a surprise to residents of temperate regions who think of Brasil as one huge, continuous entomological paradise. One cannot simply open a map and look for potential forested areas, then go there. More often than not the forest no longer exists or has been replaced by second-growth woods or relatively uninteresting bushland. Thus, the only sure way to find good collecting or watching places is to travel widely and to watch for woodland, then to try out such spots as one finds during several times of the year. All this can be very time consuming. Besides, discovering a wooded hill some distance away is one thing, while actually getting there is something else again. Generally there are no roads from the highway other than those leading to small towns, to farms or to sugar factories.

It was very fortunate, therefore, when a new roadway was constructed from Recife to the interior of Pernambuco state a little over twenty years ago. Since the new road ran directly through heavily wooded and hilly land, several tracts of fine old forest became accessible. At the time, the German Professor Dr. Heinz Ebert taught at Pernambuco University in Recife. An ardent student and collector of butterflies, he systematically searched for good collecting sites in the area. In this way he came upon the Forest of Tiúma in the Municipio of São Lourenço da Mata, some 32 kilometers inland from Recife. Very soon Professor Ebert saw that he had discovered a real jewel of a forest for butterflies. It was mainly there that he conducted his studies on the frequency of butterflies in Northeastern Brasil, which were published as Supplement Three to Volume 23 of the Journal of the Lepidopterists' Society in 1969.

At first sight, Tiúma Forest does not look very different from any other tropical forest; but once collecting has begun, one soon discovers that this is a very special place indeed. I know virgin forests in Northeastern Brasil that are in much better condition (such as Gargaú Forest near João Pessoa, Paraíba, where Morpho menelaus abounds along with few other butterflies). None, however, can match Tiúma in diversity and abundance of insects. Since I began intensive collecting there some ten years ago, great parts of the forests have been cleared to make room for sugar cane plantations. But when I learned of plans to cut down almost all the rest of it two years ago, I decided that some sort of responsive action was imperative. I appealed, therefore, to Professor Paulo Nogueira Neto, Special Secretary for the Environment in the Brasilian Federal Government, to save the forest by his power to withdraw land from development. My plea for the saving of what was left of Tiúma Forest was strengthened by letters from Professor Heinz Ebert and Dr. Keith S. Brown, Jr., both major students of Brasilian butterflies. The Secretary, a very active and efficient man, acted immediately by contacting the present proprietors of Tiuma and placing the Forest under Federal protection. Thus was this superb habitat for morphos saved from current threats, so that a magnificent resource might be kept for all the people, rather than being sacrificed to the short-term gain of a few.

Now that the saving of this morpho forest has been described, I will proceed to depict Tiúma itself.

At present, Tiúma Forest consists of about eight to ten square kilometers situated around a small lake and along a brook, at 50 - 150 meters above sea level. From the highway the forest slopes steeply down to the stream. The upper portion has been disturbed by settlers living nearby, but further down occurs dense jungle.

In all the woods I know in Northeastern Brasil, the best collecting areas lie toward the west. The prevailing winds here are easterlies (Trade Winds from NE, E and SE) and I have found that not much flies in the eastern parts of the woods, as though the butterflies had been blown westward little by little! In Tiúma the highway runs along the western edge of the forest and, as a result, much can be observed and collected right from the start of a visit.

As Prof. Dr. Ebert has demonstrated statistically, there are distinct flight seasons for butterflies at Tiúma. After the long, hot and dry summer months from October to April the rains begin to fall and nature grows green and lush again. The lowest frequency of butterflies occurs in April. The first individuals of the rainy season show up in May. In June the number increases rapidly and reaches its peak in the midst of the rainy season in July. Then follow two months when the number diminishes somewhat and many of the butterflies are old and tattered. In September the rains stop little by little and in October and the first half of November the second peak in frequency occurs. At this time, collecting trips are more rewarding because the weather is generally good; whereas in June and July, frequent and heavy rains constantly hamper collecting activities. On the other hand, in October the climate is hotter and collecting in the sweltering forest becomes extremely tiresome. From November till May, not much of interest can be seen although there occurs still another little peak in frequency in February. Having to travel 135 kilometers from João Pessoa to Tiúma, I prefer to limit my activities there to the two main flying seasons.

The butterfly fauna of Tiúma is of extraordinary variety and offers constantly new surprises. To realize this fully, one must collect systematically over several years. Although the most casual visit is worthwhile, in one or a few days it is hardly possible to encounter even a fraction of the species present there. One should, optimally, be acquainted with all the favorite haunts of the various species as well as the preferred hours of activity and season of flight.

In Tiúma Forest occur most of the typical species of the coastal zone, including the elusive Parides zacynthus polymetus, a swallowtail which flies generally in humid woodlands along the Atlantic Coast. The other three swallowtails of the Northeast are rarely seen because they prefer open country (Papilio thoas, P. polydamas and P. anchysiades capys). Pierids are numerous, especially those preferring wooded habitats such as Itaballia demophile, Perrhybris pyrrha, Leucidia brephos (the smallest known pierid); and in clearings, several species of Eurema as well as Phoebis eubule, P. argante and P. philea, Appias drusilla and Pieris orseis. Satyrinae are well represented by Taygetis and several species of Euptychia, the most conspicuous of which are E. hesione, and (flying in the early morning) E. chloris, with its pretty blue hindwings. Pierella rhea and P. dracontis are difficult to catch because they fly close to the ground in the dense undergrowth, so that one stands helpless, net in hand, unable to get at them!

Danaines and ithomiines fly about everywhere in numbers: Mechanitis nessaea, Ceratinia vallonia, Scada reckia, Thyridia singularis, Dircenna dero and Lycorea halia. Once only, I captured a species of Hirsutis which looked exactly like Heliconius sylvana ethra. It is called, appropriately enough for a mimic, H. pseudethra. Of the actual Heliconius, all the Northeastern Brasilian species occur at Tiuma: besides H. s. ethra there are H. ethilla flavi-

maculata, H. erato phyllis, H. melpomene nanna and H. sara apseudes. Then there are many colorful brush-footed butterflies including Metamorpha dido, M. steneles and four species of Adelpha. Of all the nymphalids, perhaps the one which will command your attention most is the big Historis orion. Along with six species of Ageronia, it is always among the first to descend to the banana bait.

Sometimes the glorious Prepona butterflies are common at Tiúma, flying wildly in the clearings as they chase one another in complex courtship routines which utilize their long, golden sex-scales. The Prepona likely to be seen here are P. demophon, P. laertes and P. meander. Recently I captured a novelty: a large male Prepona with a strong, violet luster beside the metallic blue stripes, belonging to the group of P. omphale-like species. It still has to be studied and determined.

The rarest and most watched-for butterflies at Tiúma are the Agrias, which fly at certain times of the year in a few selected spots in the forest. One of these is a population of A. pericles ferdinandi discovered by Prof. Ebert and described by Dr. H. Descimon in Paris as form "eberti." Later I found another variation with a feeble skyblue spot in the apex over the red of the forewings, which was named "kesselringi" by Dr. Descimon. These forms of A. pericles provide a link to the populations flying in Central Brasil and the Amazon region. Thus it came as a special surprise when I discovered, two years ago, a second species of Agrias for Tiúma: A. claudina, which has its affinities with the Agrias of South Brasil and in closely related to A. claudianus from Santa Catarina. I am still trying to find out the food plants of these two species so that some day I can breed them.

So far all specimens of Agrias have been captured on the west slope of the stream-valley. On the east slope I have never observed a single one, in spite of numerous banana baits I have set out. It seems from my observations that Agrias fly in limited territories which they seldom leave. At one place I have watched Agrias many times over the years flying around a certain tall tree. For hours they behave in this manner, flying about 15 meters above the ground, alighting from time to time on the tree trunk and remaining there for some minutes, head-down, wings closed over the back, resuming afterward their flight which was extended sometimes to some neighboring trees. As a rule Agrias begin to fly when the sun is already high in the sky; should they choose to visit a bait on occasion, they do so around mid-day. Traditionally, such baits have been employed as the best means of getting close to these brilliant, red-and-blue tree-top dwellers.

Other particularly attractive residents of Tiúma Forest include Catagramma astarte, which can be quite abundant and is easily baited. The females are almost the same fiery red as the males and look rather like small Agrias pericles ferdinandi. It often happens that I mistake a C. astarte female for an Agrias when it see it from some distance away on a bait. I am not the only one who gets fooled: I have observed Catagramma males chasing Agrias females for minutes at a time! Another Catagramma flying at Tiuma is C. pygas, but it is rarely seen. Once I caught a male of the lovely C. sorana, but not in the forest itself. It flew, rather, in the open country nearby. This was a rather remarkable catch because C. sorana is a typical butterfly of the Interior, not of the Coastal Zone. Two other Interior Brasilian butterflies which have turned up at this remarkable forest are Anaea hypna forbesi and A. moretta, both of which I have repeatedly bred. The leaf-like A. zaretes also haunts this deep wood, in addition to the most colorful of the forest Anaea species, A. siderone nemesis. Here the females of A. siderone are the same glowing red as Agrias pericles ferdinandi and Catagramma astarte, whereas in Pará, the females of A. siderone and of Catagramma are orange or even yellow, presumably to mimic the local orange and yellow forms of Agrias pericles trajanus and A. aurantiaca.

In addition to these large and showy butterflies, Tiúma nurtures many species of hairstreaks, metalmarks and skippers. Their diversity, especially to the temperate region lepidopterist, can be quite overwhelming.

Since this article is entitled "The saving of a morpho forest, " it would be well to mention the morphos. Of course, they are what most people think of when Brasilian butterflies are mentioned, and they remain a consistent and chief issue in wildlife conservation. With their massive and exquisite blue wings, they cannot do other than to fascinate and arouse the naturalist, or anyone else who happens to see them; and in Tiúma, this can still be done.

Three species of the genus Morpho live in Tiúma Forest. The everpresent M. achilles achillaena can be found in almost any piece of woodland on the Coastal Zone, even secondary forest and scrub. It is a hardy species which adapts well to many kinds of environmental and climatic conditions, and flies in varying numbers throughout most of the year. This morpho's food plants are abundant: Inga, Machaerium aculeatum, Pterocarpus and several others. M. a. achilleana is probably the easiest member of the genus to breed. From the hatching of the larva to eclosing of the butterfly it takes about 54 days here in the Northeast (but well over 70 days in the cooler South of Brasil where the form "violaceous" flies).

The large and familiar Morpho menelaus also occurs in Tiúma, but it is very rare here. Prof. Ebert found a new population here nearly twenty years ago, which Dr. H. Fischer of Augsburg, Germany named ssp. eberti. It is quite distinct from the Amazon subspecies, resembling somewhat the southern M. m. tenuilimbata. Over the course of the years I have discerned a few other places where this morpho flies, but it is mostly rare; so the Tiúma population remains very significant.

The third "blue" morpho of Tiúma I discovered there myself in November, 1971. It seems to represent an undescribed entity in the M. perseus complex. This was really astonishing because M. perseus and its many ssp. occur in the Amazon region almost solely. There these butterflies may by all shades of brown to yellow, blue, gray-blue or violet; but the Tiúma form varies little in its dull, brownish color. As in Amazonia, M. perseus flies twice a year at Tiúma: in May and again in November, rarely in between. The flight pattern of the species is quite characteristic, resembling that of M. hecuba and M. cisseis -- rather gliding, with occasional short strokes, instead of fluttering; high up at 10 to 12 meters above the ground in clearings along paths and waterways. I have never seen the Perseus morpho at bait, and those here usually ignore the brown-yellow flag with which I try to attract their attention. As a result, it is almost impossible to catch specimens. Those I have managed to net were old and battered and, for this reason, were flying nearer to the ground. I have never had a chance to observe a female, but once I found a nest of 15 larvae on a creeper dangling from a tree. Nearly full-grown, they were very conspicuous in their red-spined skins. Only five looked really healthy, the rest being parasitized. As I had no source of food plant at home, I took with me only three specimens which I preserved in alcohol.

Elsewhere in Northeastern Brasil exists still another species of Morpho in some remaining coastal woods. This is M. epistrophus (=laertes) nikolajewna. It is rather surprising to me that I have never encountered this morpho in Tiúma even though its food plants, Inga and other trees, are common there. Of course this does not mean that it does not fly there; it might simply be vary scarce and have escaped observation. Perhaps the discovery of Morpho epistrophus is one of the future thrills which Tiúma holds in store for those who will come to admire and study its rich community.

The Forest of Tiúma represents a unique, extremely interesting and precious relict of the virgin forests which once covered most of coastal Brasil. Most probably there is nothing to compare with it in the entire Northeast. The destruction or alteration of this special habitat would mean an irreplaceable loss to science and to the people. Research must continue and be intensified in this little-understood ecosystem, particularly in entomology and botany, so that we can better understand its workings and its best possible management for conservation. The continued protection of Tiúma Forest is a worthwhile objective at all costs. X

ARE MORPHOS ENDANGERED?

Jorge Kesselring

(Ed. Note: In order to help readers of Atala deal with the perplexing and controversial question of the conservation of the superb blue butterflies of the genus Morpho, we asked author Kesselring (see previous article) to address the question in the title above. His views are consonant with those expressed by the eminent Brasilian conservationists and lepidopterists J. C. M. Carvalho and Prof. O. H. H. Mielke, as published in the Proceedings of the 19th International Congress of Entomology (Moscow: 1972) I: 486-488.)

Much has been said and written about danger to the morphos from overcollecting, their beauty creating such a great demand for specimens for collections and artwork. But is collecting them the real villain?

For many years I have studied Morpho in the wild and observed their behavior, and have reared several species regularly. My conclusion is that collecting can hardly endanger the survival of these magnificent butterflies. So why is it that they tend to disappear from many regions?

Most species of the genus Morpho are rather common in tropical Latin American forests, but the individuals observed on the wing are nearly all males. The females spend most of their time hidden in dense vegetation, kept busy laying eggs. The few that come out into clearings or pathways are generally old and worn; taking one for rearing purposes yields, as a rule, only a few eggs, and these not always fertile. Thus even mass collecting of males (one of which can fecundate several females) in no way impairs whole populations of morphos, and it is almost entirely males which constitute the very large trade in adults. Survival is assured by the high reproductive capacity of the insects: each female, which is mated soon after emerging, lays up to 100 eggs. Laws which attempt to protect the morphos and other butterflies by forbidding collecting may be well meant, but they miss the real problem completely. They may also serve to distract attention from the genuine issues which do endanger butterflies, by making the legislators feel that they have already discharged their responsibilities to protect rare wildlife. What endangers Morpho butterflies are not collectors, but alteration of habitat in at least two major ways: 1) Outright destruction of specialized habitats by wholesale clearing of forests; and 2) pollution, especially by insecticides. While particularly intensive catching of morphos in some areas might temporarily diminish the population of males, forest clearing and spraying can wipe out entire populations of many butterfly species and other insects in the long term as well as short term perspective.

Additional causes for the reduction of Morpho do exist in some regions, and one of them, at least, seems quite natural. For example, Morpho aega of South Brasil is probably the most abundant of all morphos and is in exceedingly great demand for decoration due to its intensely brilliant blue coloration. Yet at more or less regular intervals of several years, M. aega becomes scarce, almost disappearing from the landscape. Why, one asks? The explanation, when sought, is quite simple. M. aega larvae feed on a species of bamboo locally called Taquara. In cycles of several years duration, this plant grows, flowers and then dies. When this happens, insufficient foodplants remain to sustain the large M. aega population which has built up. The morphos necessarily "crash" and become rare. Then in the course of the next few years, as young bamboo shoots grow up again, M. aega makes a rapid comeback and becomes numerous once more -- IF the forest is still there by then.

I was able to study first-hand another case of Morpho diminution right here in João Pessoa, where I am the only collector and where no trade collecting whatever takes place. It concerned Morpho epistrophus (=laertes) nikolajewna. This species is univoltine, flying from the middle of April to the end of May. When I came here thirty years ago, this Morpho was plentiful in surrounding forests. Since then, of course, most of the woods have gone. Only one comparatively rich, second-growth forest is left in the immediate vicinity of the city. It is now protected since it serves as a watershed for João Pessoa. So quite incidentally, this little forest turned into a sanctuary for many butterflies, including M. epistrophus, and every year great numbers turned out to fly. Then, a few years ago, a steady decline in numbers began, even though the habitat remained intact.

While in former years I could easily breed up to one hundred specimens per year from nests I found in low shrubs, now I could rarely discover any at all. Also, the number of larvae in each nest had diminished from an average of about thirty to a mere ten to fifteen. In addition, most of these did not make it to the pupal stage even in the protection of my breeding cages. If there was no habitat destruction and no insecticides were used, what might the cause have been?

I am fairly sure that I have found the culprit: heavy pollution from the local cement factory spreading its cement dust over the city and its neighborhood. With the leaves covered by this dust, so heavy that not even strong rains could wash it away, it seems that the larvae were affected little by little during their eleven-month feeding period. The dust seems to have a cumulative effect over long periods of time. Caterpillars of Morpho achillaene in the same area, which feed for only about 42 days before pupating, did not seem to be affected.

Now the cement factory has installed powerful filters. Pollution has practically disappeared from that source, and the local population of Morpho epistrophus may well be saved.

Conclusion: Yes, certain Morpho populations are endangered, together with many other butterflies of the Neotropics. This danger comes not so much from collecting as from massive habitat change. The solution, it seems to me, is the establishment of more special nature reserves, such as the one at Tiuma; and the taking of special care in the use of insecticides and the dispersal of other pollutants. X

The Xerces Society barely has begun to address the immense problem of insect conservation in the tropics. So many intense demands are made on American, African and Australasian tropical ecosystems that nature conservation takes a very tenuous stance in such areas. This is not to say that governments, biologists and the public of equatorial countries are oblivious to the need for protection of their unique ecological attributes; but that economic and political expediency relegates wise, long-term resource planning to a low, tertiary position. Thus we are glad to begin looking at tropical butterfly management dilemmas through the experienced eyes of Jorge Kesselring. Articles on the giant birdwings of Papua New Guinea, West African insect conservation and other tropical issues will follow in future numbers.

The XS policy on collecting states that the taking of insects is not officially to be condemned unless it clearly endangers populations. On this basis, the balance of evidence seems to acquit trade of any major role in Morpho endangerment. A Brasilian law requiring all trade morphos to be bred cannot easily be followed nor enforced; but a habitat protection ordinance could have great implications. Of course, the Society supports efforts to improve breeding procedures, as well as to shift any trade profits into the hands of indigenous people in genuine need of income supplement.

Xerces members are free to form their own personal attitudes, and many of us will find the killing of millions of beautiful morphos for jewelry and other decorative purposes personally distasteful. For our numerous readers who abhor any connection between butterflies and lucre, we have one happy report to make: There is absolutely no truth to the line in the popular movie Papillon, spoken by an agent purchasing morphos from jungle prisoners, which asserts that their wings are used in American mints to produce dye for U.S. dollar bills!

THE STATUS OF THE VALERATA ARCTIC

Robert Michael Pyle
Forestry & Environmental Studies, Yale University, New Haven CT 06511

Pleistocene patterns of ice travel and the responses of northern butterflies led to the present-day occurrence of post-glacial, mountaintop relict populations of Arctic butterflies of the genus Oeneis. Because of their rarity and isolation and the scenic nature of their haunts, a special mystique has grown up around certain of these arctic-alpine island butterflies. Three of them have become the objects of conservation interest. One, the famous White Mountain Butterfly (Oeneis melissa semidea), endemic to the high White Mountains of New Hampshire, elicited one of the earliest statements of concern for an American butterfly (Grote, 1876); and has been a focus of a recent dispute over further development atop Mt. Washington. Another, the Mt. Katahdin Arctic (O. polixenes katahdin) became the object of a controversial and probably ill-informed collecting ban in Baxter State Park, its sole home. The third member of this thin-air trio, O. chryxus valerata, recently joined forty other United States butterflies on a Notice of Review (Greenwalt, 1975) which proposed their listing by the Fish and Wildlife Service as Threatened or Endangered Species. This paper considers the reasons for the proposed listing of the Valerata Arctic; reviews what has been known about the insect and summarizes new findings of the writer's; and makes a recommendation on the status of the butterfly to the Office of Endangered Species.

The Valerata Arctic, by Sarah Anne Hughes.

A narrow endemic. The Valerata Arctic was discovered in the 1930's and described twenty years later as a new subspecies by William N. Burdick (1957). When O. c. valerata came to light, few collectors had visited the immense Olympic Mountains of Washington State. But as access improved through the building of the Hurricane Ridge Road, and as Burdick and others continued to describe exciting new races of butterflies from the Olympic Peninsula, more lepidopterists arrived on the scene. Even so, nearly forty years after its first finding Valerata was still known only from a very few sites in the immediate vicinity of Hurricane Ridge in Olympic National Park. All specimens and records I have been able to locate originated at Hurricane Ridge, Hurricane Hill or Obstruction Point, all points on a narrow transect of less than fifteen kilometers in length. This suggested that O. c. valerata was one of the most restricted butterflies in North America.

Why proposed for listing. Since its total range seemed so very small, lepidopterists have been uneasy about Valerata for some time. While Olympic National Park contains almost no developments, a major paved road to the center of the Ridge introduces hundreds of thousands of visitors to O. c. valerata habitat each year. These people are served by a lodge, picnic grounds, interpretive facilities and a minor winter sports area. The concern has been over the possible extent of future additions to these accoutrements, and the sheer physical impact of people on the tundra.

Since the Wilderness Act of 1964, speculation has flowed over how much of the park would emrge as formal wilderness, forever roadless. Most observers have felt that a large Wilderness Area was inevitable and proper; but the potential for increased development in excluded places has persisted as a nagging side issue. For as Pyle (1974) indicated, major physical developments at Hurricane Ridge might conceivably imperil the population of O. c. valerata.

The second large concern was direct human impact upon the habitat. Valerata Arctics live on the tender tissue of the alpine tundra, which in Washington occurs over 6000 or 7000 feet above sea level. Bell and Bliss (1973) showed that marked deterioration of the grass-sedge sward in the vicinity of Hurricane Ridge had occurred due to trampling of the turf by visitors away from trails. Further development, which might predictably attract more visitors, seemed a very real threat to the high-country grasses which nurture the larvae of the Valerata Arctic.

When the proposed Master Plan for Olympic National Park was published (anon., 1974), the entire known range of O. c. valerata was placed in Class II: General Outdoor Recreation, in the land classification scheme set forth by the National Park Service. This did not seem advantageous to the narrowly endemic Valerata Arctic and its community.

Therefore, early in 1975 when Dr. Paul Opler of the Office of Endangered Species sought butterfly nominees for proposal as possible Endangered and Threatened Species, it was considered the properly cautious thing to do to suggest Valerata. In addition to alerting State and Federal authorities to the insect's significance, the action provided impetus for studies which might illuminate its ecology. The Valerata Arctic was indeed included in the Notice of Review, the only representative from the Pacific Northwest and the only member of the satyrine genus Oeneis to be so considered.

The Valerata Study. The Xerces Society believes firmly in the value of listing Threatened and Endangered Species, primarily inasmuch as that process can influence the protection of critical habitat. However, for this system to retain its usefulness and its integrity, the listings should be made on the basis of the most complete information possible. Listing animals which qualify only marginally or not at all could only serve to water down and demean a very powerful tool. In the hope of bolstering our understanding of this organism, I placed field studies of O. c. valerata on my research itinerary for 1975. These investigations addressed four questions:

1) What is the actual distribution of the butterfly?
2) Is the population actually affected by human impact?
3) What is the political situation surrounding the butterfly and its habitat, and what attitudes among officials bear upon their conservation?
4) Should Oeneis chryxus valerata be officially listed as a Threatened Species (one which might become endangered in the near future), as an Endangered Species (one which is in imminent danger of extinction), or not at all?

In addition, I hoped to learn as much as possible about the natural history of the animal, so that management recommendations might intelligently be made. In part, at least, results were obtained relating to each of these areas of inquiry.

Prior to setting off for Washington, I notified Carroll Rieck, head of the Non-hunted Wildlife Program of the Washington State Game Department, and Roger W. Allin, Superintendent of Olympic National Park, of the intentions and scope of my proposed research. Mr. Rieck, as the state official responsible for reporting to the Governor on the status of Valerata, welcomed the investigations. Mr. Allin, chief administrator

of Valerata's habitat, likewise indicated a cordial and cooperative stance on the part of Olympic National Park.

On July 11, 1975, I arrived on the Olympic Peninsula to begin work on the Valerata Arctic. Although I had found the butterflies on the wing in June in early years, Arctics are very much the pawns of the weather: this year the snow cover remained over much of the Olympic tundra until quite late in the season. At this midsummer date, only patches of habitat had greened. Accompanied by Sally Pyle, H. Whetstone Pyle and David P. Shaw, who assisted throughout the study, I went directly to the classic locality on Hurricane Hill. Here, at about 5600 feet, O. c. valerata was present in good numbers on that first day. We were naturally very excited to see the first flash of their tawny wings, but we soon settled down to observing individuals carefully to determine micro-habitat preferences and plant associations. At least fifteen other species of butterflies flew prolifically beside the popular tundra nature trail on Hurricane Hill, along with the magnificent, rosy day moth, Hemileuca nuttalli. This fauna constituted perhaps the finest and most colorful interpretive display of Lepidoptera I have ever witnessed at one place and time in a national park. Unfortunately, the visitors had no source of information about the butterflies and moths, which were so conspicuous. That they were indeed interested grew apparent from the many questions we were asked when our attention to the butterflies became obvious to hikers. Clearly the large, puma-hued Valerata Arctic drew substantial visitor interest, especially when it alighted, closed its wings and vanished into the lichenous shale.

On the late afternoon of July 11, our party substantiated a long-suspected locale for O. c. valerata. This was at Deer Park and Blue Mountain, approximately twenty kilometers south-southeast of Hurricane Hill. This locale lies within the national park, on the only other auto road (a narrow, steep route not often taken by flatlanders) which reache the Olympic high country. This site was also classed "General Recreation" in the Park Master Plan, and it receives fairly heavy impact from visitors. A single female Valerata Arctic was found by Sally at Deer Park, while David netted a male on the summit of Blue Mountain at 6007 feet.

The following day, July 12, brought continued sun and warmth, so we searched along the trail from Hurricane Ridge north along Sunshine Ridge toward Mount Angeles. Numerous natural history notes, chiefly behavioral, taken along the way will be published elsewhere along with life history information. What is germane here is that O. c. valerata occurred along much of this trail, in suitable habitats, sometimes quite abundantly. At times half a dozen individuals could be seen at once -- likely including a female or two flying low over the sedges and several males circling high in the air in mock courtship. They were not the sole attraction, and sometimes it was difficult to concentrate on them alone, with swallowtails, parnassians and five species of blues coursing the trail. Sally found herself distracted by a ant which was, by itself, carrying off a chrysalis of Phyciodes campestris, a crescent-spot which was very common at that spot. For at least three kilometers from Hurricane Ridge, we encountered Valerata. The farthest extension of its known range to the north came about as I observed one individual on the rocky, steep fellfield below the south side of the summit of Mount Angeles. This brings the butterfly to the very northern rim of the timberline Olympics, within fifteen kilometers of the Straights of Juan de Fuca. Our descent was shrouded in mist. Mountain Goat fleece clung to low shrubs, and at the bottom, David and I looked up to see the shaggy, cream beasts where we had stood.

The mist remained and thickened into a classic Washingtonian cloud, in which we lived for the next ten days at Heart O'the Hills Campground. Winter precipitation in the Olympics reaches records of 150 inches and more, but summers are generally rather more dry. For one chilled, drenched day we prowled the gray tundra up above in search of eggs or larvae, with predictably poor results. After that, we tended specimens and recorded notes in Port Angeles taverns, huddled in the damp to hear ranger naturalist programs and tried with less success than the ranger to light our own campfire. In the Olympic Rain Forest in the rain, ignition is nearly impossible.

A few miles from the park lies the Sequim Rain Shadow. Occasionally the sun shines here while the Olympics remain swaddled in wet, wooly clouds like vast clumps of sodden Mountain Goat fleece. We brought our female Valerata to the Rain Shadow in the hope that stray sunshine might stimulate egg-laying, which it did. And since my studies of Washington butterfly biogeography dictated that we sample broadly over the state, some useful digression came from these flights from the rain. Notably, we came upon a highly unexpected colony of Colias occidentalis on an unusual heathland of Ocean Spray and Manzanita at the foot of spectacular Dungeness Spit.

But as the flight season of the Valerata Arctic dribbled away, so did our plan to conduct experimental research on visitor impact. The idea was to carry out mark-release-recapture studies on the butterfly (a means of determining approximate population levels) at both heavily impacted and relatively untouched habitat sites, and to compare the results. In this manner, I had hoped to test whether the kinds of visitor trampling effects measured by Bell and Bliss affected the observable numbers of Valerata Arctics. Some impressions on this matter were gained through qualitative observations, and these will be discussed below.

The rain-bound period did offer other opportunities to advance the study. Primarily, it afforded generous opportunities for conferring with National Park Service officials. On several occasions I met with Mr. John Douglass, Chief Park Naturalist of Olympic National Park. Having had some experience with Lepidoptera, particularly in the rearing of desert species, he held a genuine interest in O. c. valerata. He was familiar with its black alpine relative, Erebia magdalena, from his tour of duty in Rocky Mountain National Park, and so he was aware of how fascinating arctic-alpine butterflies can be in their special adaptations to harsh conditions. Mr. Douglass gave me the strong impression that he regarded Valerata as a major scientific and interpretive resource which the park should carefully guard. I was unable to meet with Park Biologist Bruce Moorhead, who was in the field; but his colleague, Resources Manager Paul Crawford, felt that Mr. Moorhead would indeed be concerned about the creature, and indicated that the two of them would watch for it during subsequent field reconnaissance in the west highlands of the park. A similar promise was extracted from Cindy Jones of the Sole duck Ranger Station.* Ms. Jones shared her colleagues' enthusiasm for learning about and conserving the Valerata Arctic.

Mr. Reed Jarvis, Assistant Superintendent, displayed strong enthusiasm for the idea of rare invertebrate conservation and interpretation in the national parks. From him I was able to ascertain that no major developments were planned for Hurricane Ridge or the vicinity: that even in this intensive-use area, the design of the Park Service was for restrained, resource-oriented recreation. The aerial tramway which had been rumored in conservation group publications is, apparently, a dead issue with no support in the agency. Seemingly the only groups pushing for major development in the park are local county commissioners and Chambers of Commerce, who have long supported a highway through the center of the park. This view does not enjoy the sympathy of the managers of this great, unroaded wilderness.

Thus heartened, I was pleased finally to meet with Mr. Roger W. Allin, Superintendent of Olympic National Park. An experienced biologist himself, Mr. Allin understands the kinds of pressures under which rare endemic organisms can come when situated in areas of human use. But he expressed concern that the Endangered Species Act not be used capriciously; and the belief that existing within a national park might well be sufficient protection for the habitat of O. c. valerata. Should that be true, he felt, the proposed listing would be a superfluous measure. Supt. Allin presented me with the official Wilderness Recommendation of the NPS for Olympic (anon., 1974), and we examined it with respect to Valerata. If the Congress acts positively on the bill to establish the proposed Wilderness Area in Olympic National Park, some 97 % of the park will be thus designated and rendered forever free of the threat of development and road-building. We agreed that one of the most essential points to determine was whether the butterfly occurs within the proposed Wilderness Area. The Superintendent's frankness, the serious manner in which he viewed the issue and his generous giving of time to our discussion were appreciated. The same can be said for each of the park employees with whom I conferred.

*As this goes to press, a negative report has just been received.

During my discussions with NPS officials, I had with me a live female O. c. valerata which we were keeping for oviposition. Her presence enabled the administrators of her habitat to relate much more closely to the organism in question.

On July 18 the clouds looked like clearing, so we attempted to reconnoiter part of the proposed wilderness segment lying between Blue Mountain and Obstruction Point. From Deer Park we hiked west toward Maiden Peak. The weather deteriorated once more and the sun shone very little as we walked this spectacular, elegantly flowered path. On a clear day we could have seen Victoria, B. C.; Mt. Baker, across Puget Sound; and, presumably, Valerata: for the habitat seemed ideal and the ridge adjoined known habitat at both ends. But Maiden Peak was wintry when we reached it, and no butterflies flew. Three days later the mountains warmed enough for Olympic Marmots to be basking on snowbanks. A final excursion took us out the still snow-closed Obstruction Point Road from Hurricane Ridge. Dr. Robert Gara, Professor of Forest Entomology at the University of Washington, joined us as we encountered scores of cinnamon-and-chocolate Vidler's alpines (Erebia vidleri) but very few O. c. valerata -- the season was retarded on this northwest slope. David Shaw did find the butterfly high on the side of Eagle Point in this section, but on the whole the gamboling marmots were the more evident and captivating of the park's endemics that day. Thereafter, we were obliged to depart the area in order to resume other research activities.

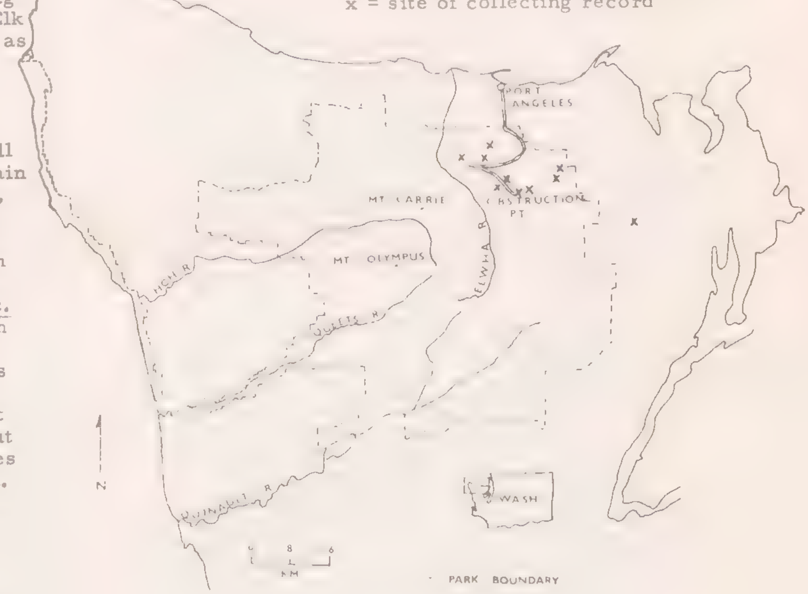
Findings. 1) The known range of Oeneis chryxus valerata was extended to include Blue Mountain, Deer Park, Sunrise Ridge and Mount Angeles. A capture by J. R. Pyle on August 12, 1967 on the trail between Obstruction Point and Elk Mountain was an additional unpublished range extension, as was Jonathan Pelham's record for Mount Townsend (a rather isolated mountain to the southeast of Hurricane Ridge, in Olympic National Forest) in 1974. The Mount Angeles record and that for Elk Mountain vicinity place O. c. valerata within the proposed wilderness area; in all probability, the butterfly occurs all along the Elk Mountain Maiden Peak - Green Mountain - Blue Mountain highland, within the wilderness enclave. It seems possible that it may range farther south in the eastern sector of Olympic National Park, perhaps as far as Mount Anderson, which would be some 25 kilometers south of the southernmost known population. However, Burdick did not report O. c. valerata from the Gray Wolf Range, the area from which he described Plebejus lupini spangelatus. So it may be true after all that this remarkably restricted insect lives nowhere but in the thin rim of peaks along the northeast, lee-ward side of the Olympic Mountains. I do not expect it to be found in the other major massifs of the park, but future collecting in remote areas will tell. Many reaches of this alpine wilderness have never seen a lepidopterist. Difficulty of access is one problem, although fine trails penetrate the back-country; the need to obtain a permit may have deterred some collectors; and rainfall and cloudy weather have certainly set back exploration (!).

2) Human impact on populations of Oeneis chryxus valerata could not be experimentally tested for reasons given above. Clearly, the butterfly flies more abundantly in some sites than in others, within its range. Habitat perameters were difficult to judge, but it seemed to us that most individuals occurred on rockier slopes with grasses, sedges and forbs but with open shale as well, between 5000 and 7000 feet altitude. Generally, sites with more than 50 or 60% plant cover seemed less attractive to both males and females. At times, individuals have been watched hilltopping on completely bare rock; and most other activity, including courtship and nectaring, takes place in areas more stony than grassy. This gives rise to the uneasy but possibly correct idea that trampling of heavily vegetated sites may in fact improve habitat conditions for O. c. valerata. At least, I cannot contend in confidence at this time that visitor impact impairs populations of this butterfly in degrees less than complete scarification. Indeed, the highest abundance observed was on the Hurricane Hill Nature Trail, an extremely well used thoroughfare. However, this report in no way intends to promote increased visitorship as a management technique! For one thing, Erebia vidleri, an extremely handsome Northwest endemic, prefers the lusher alpine meadows and could well lose ground to human trampling. Major developments, of course, could destroy populations of O. c. valerata. But as I have said, this appears highly unlikely in the park.

3) The receptivity, attitudes and convictions of all Olympic National Park personnel whom I interviewed came across as excellent from the Xerces Society's point of view. It was heartening to find that they accepted rare insect conservation as a serious and worthy park management objective. Their candor was appreciated, and I was convinced that any serious management recommendations which emerged from my research would be earnestly considered. The NPS officials evinced the strong and unanimous belief that no activities should be allowed to take place which would jeopardize Oeneis populations in the park. In short, the Valerata Arctic has been placed on the agenda of ONP resource managers, alongside the Roosevelt Elk, the Flett Violet and the Olympic Rain Forest, the high peaks themselves and the wilderness coastline.

4) Our understanding of the biology of this mountain relict species increased with these studies. Ova obtained from the captive female yielded larvae which diapaused during two weeks in a Seattle refrigerator and were subsequently tended in cafes and truck-stops all the way to New Haven. Presently, one fourth-instar larva remains alive and has entered a second diapause, which might indicate that the insect exhibits biennialism in nature. The preferred foodplant was not determined, and although we have our suspicions, our larvae have had to make do with various lawn grasses. A great deal of field work remains to be done with this taxon. Those details of its natural history which we were able to learn will appear in another journal, with photographs of the immature stages. *

The Olympic Peninsula (after Bell & Bliss, 1973), showing distribution of O. c. valerata. x = site of collecting record



Should future management questions arise, certain answers might relate the the Valerata Arctic. For example, one wonders what kinds of climatic changes the butterfly could withstand; one agency urged weather modification as a proper park use. Furthermore, one may ask quite seriously what effects the exotic Mountain Goats will exert on Valerata and other butterflies. Numbers of individual arctics were lowest on Mount Angeles of all sites I surveyed: Mount Angeles harbors the largest herd of the introduced goats in the park. It would be interesting indeed if the situation produced a management conflict pitting a magnificent mammal against a dun butterfly. Such a conflict already exists between the goats and some of the endemic Olympic wildflowers, according to one botanist. As a rare endemic, I believe Valerata would have the edge over the introduced ungulate. Another question, this one genetic, suggests additional future research. It is possible that Valerata has speciated during its isolation in the high Olympics. Cross/backcross experiments with Cascades O. chryxus chryxus might indicate whether O. valerata has achieved speciation through reproductive isolation. While biologists concern themselves with conserving populations, species mean more than subspecies to politicians.

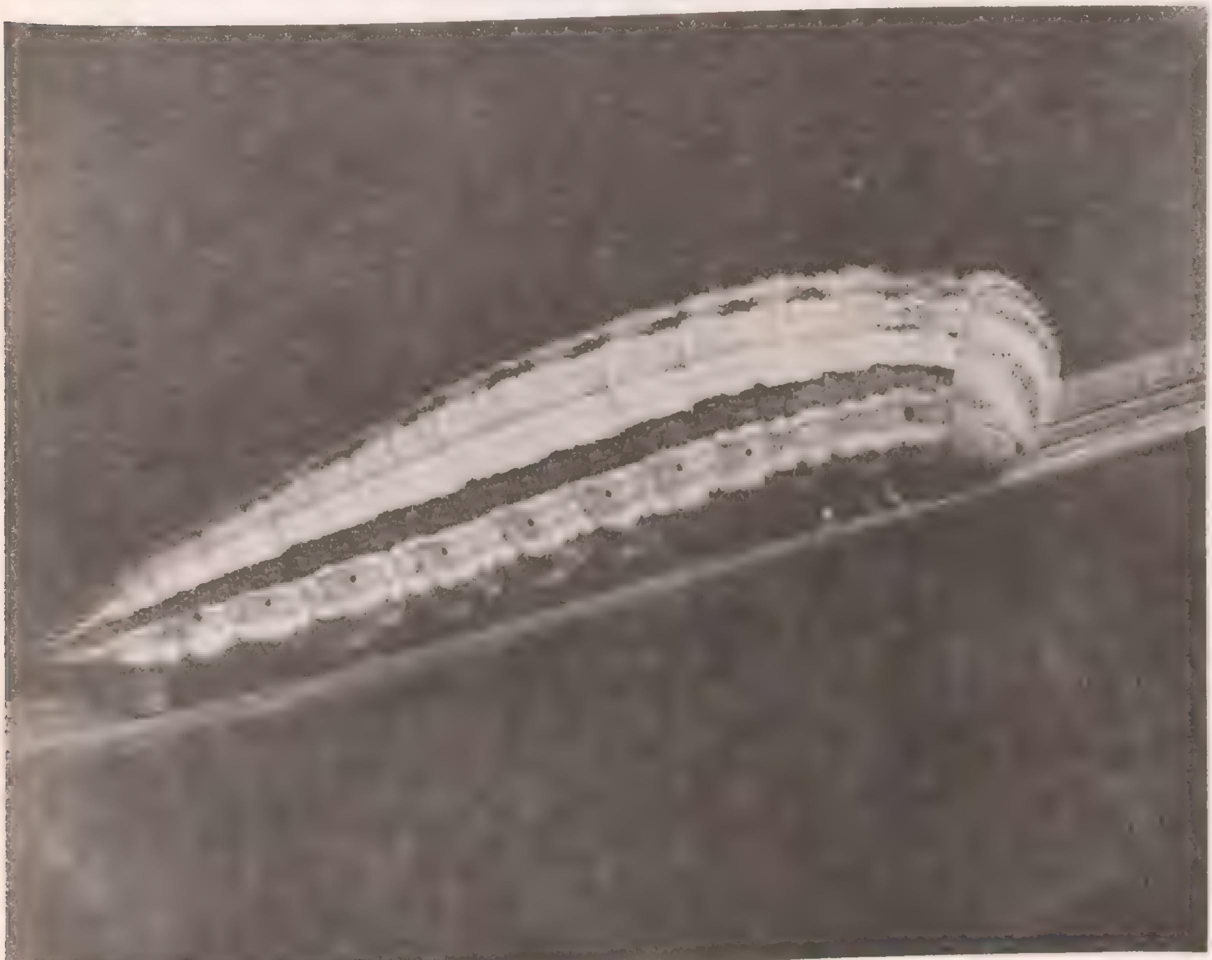
* Larval material has been preserved in the Yale Peabody Museum of Natural History.

Conclusion. In my opinion, sufficient evidence has been accumulated to warrant the following recommendation to the Director of the Fish and Wildlife Service, United States Department of the Interior:

> Oeneis chryxus valerata need not, at this time, be placed on the Federal List of Threatened and Endangered Species. While the taxon is a highly restricted endemic, its numbers are not low where it occurs. The range of O. c. valerata includes at least thirty kilometers of alpine ridges, some of them within a proposed Federal Wilderness Area, where major habitat disruption seems unlikely. The management and protection accorded to the organism as a denizen of Olympic National Park should be adequate, in the judgement of this representative of the Xerces Society.

I concur with the Hon. Daniel J. Evans, Governor of Washington, who responded carefully and at length to the Office of Endangered Species' Notice of Review which proposed O. c. valerata for listing. In part, Governor Evans wrote:

> "It is my opinion that Oeneis chryxus valerata does not meet the definition of endangered or threatened in that it is not now, or in the foreseeable future, threatened with extinction. . . . Valerata can better be described as an uncommon butterfly of great scientific interest." X



Fourth instar larva of Oeneis chryxus valerata, actual size approximately 20mm.
Photographed by Andrew Skolnick.

Acknowledgements: Thanks be to Sally Pyle, H. Whetstone Pyle and David Shaw for their patience with the weather and the writer and for their help in the field; to the employees of Olympic National Park, named in the paper, for their valuable insights and for permission to collect specimens and to undertake studies in the park; and to Professor Charles L. Remington for helpful discussions concerning various aspects of the study. Financial assistance is recognized from Sigma Xi, the Scientific Research Society of North America.

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BUTTERFLIES AND THE AUBURN DAM

William D. Patterson
5323 Jerome Way, Sacramento, CA 95819

By the year 1983 a total of 48 miles of deep canyons will have been inundated by the back-up of water behind the US Bureau of Reclamation's 700-foot high Auburn Dam.

The Auburn Dam impoundment was authorized by Congress in 1965 at a cost of about $250 million. The cost is now projected at $850 million, and by completion it will probably soar to more than $one billion. The benefits of the project were calculated in 1965 at four times the cost. Although this figure is no longer valid and probably never was (it was based upon artificially low interest rates, highly subsidized payments for the water and grossly exaggerated recreational benefits), it was accepted by Congress and cannot legally be challenged. A thorough economic analysis conducted by the Sierra Club shows that this project will fail to repay its costs by about $1.3 billion over the 70 year repayment period. This is primarily because the Bureau is planning to sell the water that it develops (75% of the project's benefits) at $6 per acre foot for irrigation and $16 per acre foot for other uses, while it will cost $37 per acre foot to develop the water. It is stated in the Environmental Impact Statement (EIS) that $9 per acre foot is about the maximum that any of the potential irrigators are willing to pay; above that price the Auburn Dam would not be needed. The scheme of the agency is to conceal the excess repayment costs of this project in the books of the financially solvent Central Valley Project; and then to raise power rates in the years to come to cover as much of the loss as they can. Other studies on power generation, flood control and recreational use corroborate the purely political nature of this devastating project.

Although work related to the Auburn Dam began in 1968, the concrete has yet to be poured. The war in Viet Nam, the Nixon Administration, the need for an adequate EIS, lawsuits brought against the agency by environmental groups, and citizen opposition (including a statement from the Xerces Society) all contributed to the delay. Still, political plums such as Auburn have a tendency to roll right along -- especially when money has already been spent -- as if spending more money can rectify a poorly thought-out and obvious mistake. The hydrologist responsible for the detailed economic studies which first suggested that this work was not in the public interest found himself quite unwelcome in Washington. His own Congressman told him that the Auburn Dam would be built and that he was not interested in any information which might hinder its progress. Once a project such as this has been authorized by Congress, it cannot be challenged on its merits, but only on the grounds of an inadequate EIS. This was done. An injunction against further construction was issued, and an EIS amendment ordered. Upon receipt of the amendment, the Federal Court ruled in October, 1974 that the EIS was now adequate. Construction resumed. Alternatives to the project (the court rejected several good ones) furnished the major issue in the lawsuit. Environmental considerations played no part in the deliberations: there were no Endangered Species involved and the only requirements of the Bureau were that they explain the effects of their actions. This they did, after a fashion. The agency's comments concerning the natural history of the reservoir site were trivial, insensitive and indicative of a deep and clear lack of concern for such values. Coverage of invertebrates consisted of a simple list of the major groupings, incredibly enough -- e.g., Butterflies, etc. Perhaps the simple-minded machinations of this self-perpetuating bureaucracy would not be so alarming were the resource at stake not so outstanding. Just what stands to be lost?

The North Fork and Middle Fork Canyons of the American River in this area plunge from 600 to 1000 feet in depth. They bear vegetation characteristic of both the Upper Sonoran and Transition life zones, occurring here in an interesting blend. The steep northern slopes support more xeric plants, including chaparral, and their associated butterflies. The southern slopes are more mesic and their butterflies reflect this condition. As one would expect, the overall butterfly picture in this riverine system is a rich one.

To date, a total of 65 species of butterflies have been recorded in the five miles of canyons immediately upstream of the dam site. Several other species have been collected in the zone above the projected waterline on the canyon slopes and ridgetops. A survey of other collectors would add to this number, since many widespread species have not yet been tallied. The butterfly fauna of the upper reaches of both canyons likely has been very little studied, as the only paved road across the canyon is near the town of Auburn, about two miles above the dam site.

The area to be impounded nurtures a number of populations of notable butterflies which will almost certainly be lost. A large, vigorous colony of Colias eurydice feeds on Amorpha californica, which is found primarily as an understory plant on the slopes of a relatively moist side canyon on the south slope. C. eurydice flies abundantly here and occurs up and down the main canyon as well. The butterfly manifests two phenotypically distinguishable broods and sometimes a third brood in August. This animal has been designated the official state insect by the California legislature; but in this part of the state at least, C. eurydice appears doomed to follow the state mammal, the California Golden Bear, into extinction. This one-time subspecies of the Grizzly appears on the California State Flag: perhaps the Bureau of Reclamation could adopt the California Dogface butterfly as a symbol of its own particular brand of handiwork.

Breeding in the same area, but on introduced watercress, is Pieris napi -- the only known colony in the interior of the state which exhibits a second brood of the "castoria" phenotype. In the same vicinity, usually perching in small, sunny openings in the forest, occur the skippers Amblyscirtes vialis and Epargyreus clarus. This portion of the canyon is densely and diversely vegetated. Except for clumps of Douglas-fir, some of the small openings along the stream are reminiscent of riparian clearings in the eastern United States.

Through the north side of the canyon runs an an old railroad line, alongside an old road. Both wind among cuts and rocky outcrops. Here the very striking Sonora Blue (Philotes sonorensis), generally considered a very special butterfly both for its uncommonness and its orange-patched appearance, is established in an extensive colony along approximately four miles of the slope. In February and March it can be quite prolific just here, lending vibrant splashes to the spare spring landscape. P. sonorensis associates itself with Hen and Chicken (Dudleya cymosa). Extensive collecting over a number of years by many collectors has had no apparent effect on this population, but the dam -- quite clearly -- will.

Perhaps the most significant unit of the Auburn butterfly complement is Callophrys mossii windi. This taxon warranted placement of the Office of Endangered Species' first Notice of Review of possibly imperiled butterflies. Although it was not among the six California lycaenids later proposed for listing as Endangered Species, C. m. windi quite obviously is none too common. Like the Sonora Blue, Wind's Elfin flies only along the north side of the American River canyon, in this portion of its range. Never numerous, the diminuitive, frosty-brown adults normally are found perching on shrubs. I have never found it associated with its usual host, Sedum spp., in this canyon.

Among the other interesting species which inhabit the canyons are Papilio multicaudata, Anthocharis lanceolata, Chlosyne leanira, Callophrys johnsoni, C. spinetorum, C. dumetorum, Lycaena arota, Paratrytone melane, Hesperia harpalus yosemite, H. lindseyi and Thorybes pylades. In addition, Euphydryas editha rubicunda, H. juba and Erynnis brizo lacustra have been collected in the nearby vicinity.

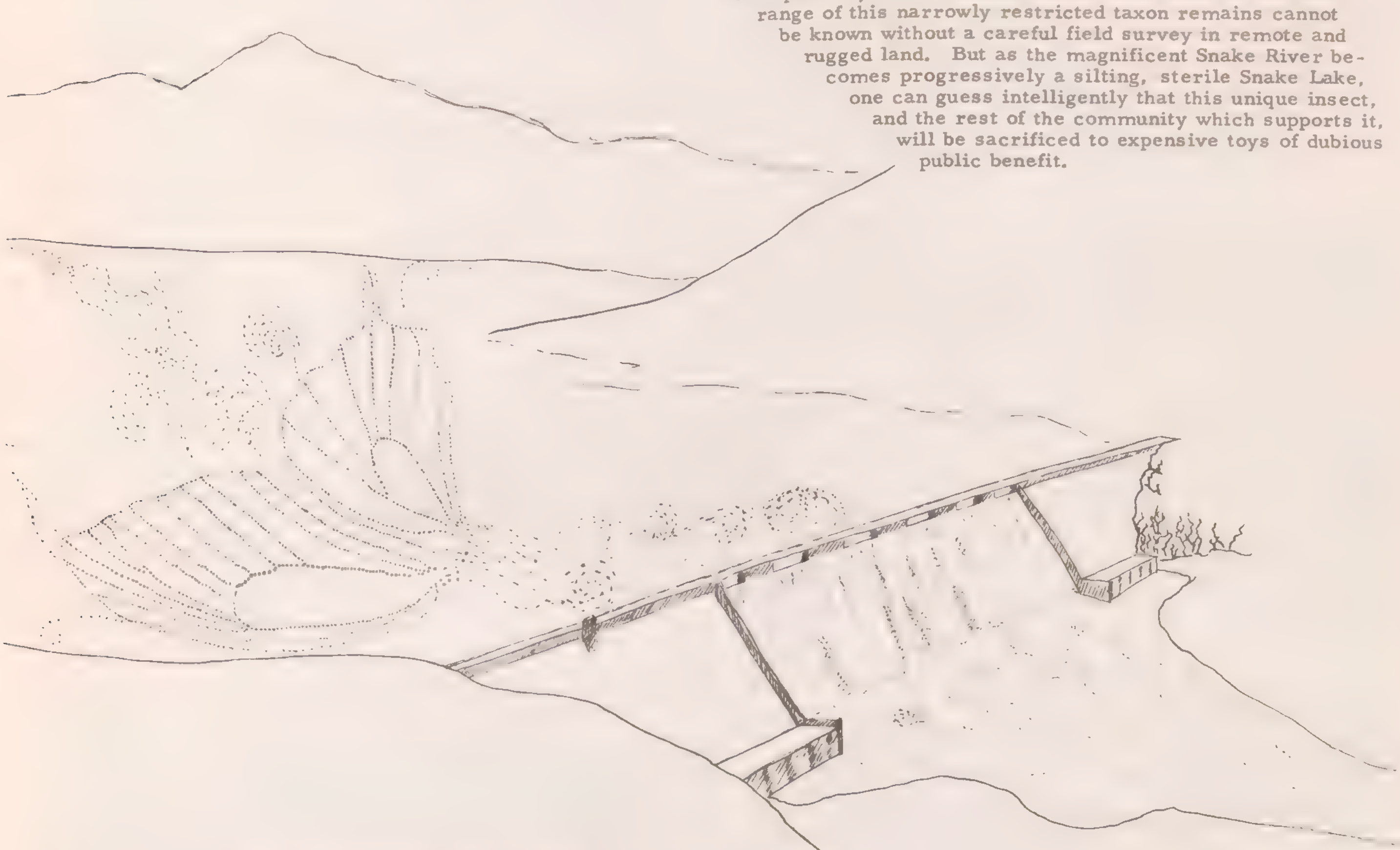
Considered by many a wasteland fit only for rattlesnakes (which I have yet to see there), these canyons comprise one of the finest places I know for observing butterflies. Their loss will be tragic. What can be done to prevent a replay? Voting may have done so already: a number of natural river champions have been appointed to key water policy posts by Governor Brown. X

DAMS. . . . an editorial

Forty years ago in The National Geographic Magazine (May, 1936), Laurence Ilsley Hewes described the habitat of the rather scarce Papilio oregonius in Washington. "Imagine a gorge with the west wall a sand chute covered with black rock float. The temperature in the shade of a willow in the bottom may be above 100°. The east wall is terraced basalt. Quietly you move along among the blistering rocks with the white sand skyline six hundred feet above." A visit to this rigorous setting could be richly rewarded, wrote Hewes, by an encounter with the spectacular denizen of the middle Columbia, the Oregon Swallowtail. Few people will have that opportunity again. A string of dams all along the Columbia has backed the waters up the canyons, drowning the canyon thistles on which oregonius nectared, and the Dragon Wormwood on which its larvae fed. Even where the swallowtails persist, the canyons have been made shallow and the river sluggish. The mystique of the wild gorge, evoked so elegantly in Hewes' article, diminished as the concrete river-tamers grew. With it went a tremendous percentage of the already limited habitat of the coulee country's endemic swallowtail.

Some three decades after Hewes wrote about the wild Columbia, Jon Shepard prowled the canyonlands of the Snake River up stream from its confluence with the tamed Columbia. At a remote place called Wawawai, he found a remarkable, disjunct population of Parnassius clodius. This arid - land deme of the usually alpine or wet-coastal Clodius received Shepard's name as a separate subspecies. Like P. oregonius, P. clodius shepardi had adapted to life in the hot black rock gorges which incise the lava flows in the region where Washington, Oregon and Idaho come together. True beasts of the basalt, these butterflies inhabit spare environments which require them to be finely tuned to conditions which people (excepting, perhaps, ardent lepidopterists and sheep-herders) find inhospitable. In doing so, they became markedly different from related butterflies. Shepard's Parnassian evolved as a much larger and duskier animal than most populations of clodius, perhaps partly in response to the dark backdrops against which they live their lives. No matter how adaptable, butterflies cannot meet the conditions imposed by certain environmental changes. The Snake has been dammed. Wawawai is under water.

The type population of P. c. shepardi, presumably, has been extirpated by Lower Granite Dam. How much of the total range of this narrowly restricted taxon remains cannot be known without a careful field survey in remote and rugged land. But as the magnificent Snake River becomes progressively a silting, sterile Snake Lake, one can guess intelligently that this unique insect, and the rest of the community which supports it, will be sacrificed to expensive toys of dubious public benefit.



By the same process, an invaluable native resource of the Northwest in the form of Papilio oregonius has been depleted such that people cannot easily appreciate it. If difficult access has always provided a challenge for watching or catching it, inundation of habitat has now added an insuperable barrier over much of the butterfly's range. P. oregonius may not be strictly endangered; but imposed rarity to the point of near invisibility cannot be considered to be a really acceptable alternative to extinction. Besides, if these organisms survive marginally the puddling of their riverine retreats, other more vulnerable animals and plants may not. We know, for example, that Cicindela columbica has been dammed out of much of its habitat along the Snake and Columbia (Atala 3:21). This tiger beetle, named by Northwest coleopterist Dr. Melville Hatch for the one-time river it dwelled along, is bound to the sandy bottoms of these great streams. It does not swim well.

There are two last chances to protect sizeable segments of the Columbia-Snake System. I say sizeable, but that is a relative judgement: fifteen dams in Washington alone have already left the great majority of these rivers' miles as stagnant slackwater, unpretty in drawdown and unprolific in wildlife. Yet there remains an opportunity. Between the McNary Dam pool and the city of Richland lies the last free-running stretch of the upper Columbia River -- some forty miles of rich riparian habitat which has been incidentally protected by the Hanford Reservation of the Atomic Energy Commission. A dam, to be named cruelly after Benjamin Franklin, has been proposed for this reach of the river. Of course, it must not be built. Meanwhile, conservationists for years have tried to secure Hells Canyon on the Snake River in Idaho, Oregon and Washington as a federal reserve to safeguard its wild character. The Xerces Society declares its intention to materially aid in the effort for the correct, ultimate conclusion to these issues during the Bicentennial Year: Creation of two of the most important river reserves in North America. Any other outcome would be more bitter to take than the swallowtail's wormwood. RMP.

Report of the Xerces Society 1st Annual Fourth of July Butterfly Count.

SO NOW YOU KNOW, those of you who counted, just how many butterflies there are in your area.

July and its insects may seem long ago, especially as the year has passed the winter solstice and returns with gathering speed to spring; but that month in 1975 saw more than sixty participants take part in the first Xerces Society Butterfly Count. Local groups were organized throughout the United States. The encouraging number of parties in the Northeast Zone was due in part to the publicity work carried out by Xerces Members Ivy LeMon and Beatrice Ridgeway. Ms. LeMon utilized her local newspaper, while Ms. Ridgeway canvassed nature centers. In the East, notable count totals were turned in by Mother Maria Nugent at the Regina Laudis Monastery, CT (36 species); and by Jo Brewer for the Isleboro, ME tally (22 spp.). Two Western counts were particularly successful in turning up new distributional data -- both Kirby Brown's count in Woodbridge, CA, and Ray Stanford's at Gilpin, CO, produced five county records. Additional congratulations go to Dr. Stanford and his group for achieving the highest count: a grand total of 62 species. Special note should be made of the count led by Jerry Powell in Berkeley, CA. Not only did Dr. Powell furnish the most elegant and careful compilation, full of enthusiasm and helpful encouragement, but his was also the very first report received. Bob Hammon's MI count heralds a special find amongst its 46 species.

After August, reports of many hues flowed in. These varied from in-depth studies of large areas to casual backyard obervations. Everyone seemed to enjoy the event, even those on the Pyles' count in Seattle which unearthed only three species in eleven hours of counting. In preparing this report, standardization proved difficult because of the variability of counts. But where possible, I followed the National Audubon Society Christmas Bird Count format. An exception is the geographical treatment, for which the Zones employed in the Lepidopterists' Society Season's Summary have been adopted. In reading this report, please keep in mind the following points: Order and nomenclature follow dos Passos' check-list of Nearctic butterflies, with certain recent revisions. Since there are no standardized English names of butterflies (as there are for birds), scientific names have been used; and to save space, only the initial of each genus is supplied. Most readers unfamiliar with these names should be able to figure them out with the help of dos Passos, Klots, Howe or Ehrlich. I have omitted information which was ambiguous and have not tried to fill in for that which was not supplied. Unsolicited data such as sex and condition are given. Where reports varied from the form suggested in Self Help Sheet #3, I followed the original rather than interpolate. The intent of this report is to share information generated by the Count. It does not attempt to correlate regional or annual data. Such abstractions should be possible when the Count becomes more sophisticated and the information more abundant. In the meantime, individuals may make what use they will of the results, kindly informing us of any such uses. Comments, suggestions and reactions will be enthusiastically received.

Self - Help Sheet #3 (May 15, 1975) set out procedures for the first Count and called for "additional notes on technique, complications or the nature of your own count." Among the replies received were further references to previously organized day counts. We apologize to Ray Stanford for missing his important article "How many butterflies in one day?" (News of the Lepidopterists' Society, No. 6, November 1972). Ray further recommends the following reference: Munroe, E. G. 1952. Special Request (concerning butterfly surveys). Lepid. News 6: 91. "A method of assessing the abundance of butterflies in Monks Wood National Nature Reserve," cited in the Self - Help Sheet, has since been published in Ent. Gazette 6: 79-88 (E. Pollard, et al). Many correspondents addressed the timing of the event in the first week of July. It seems that in aiming for a time when some butterflies would be flying in all parts of the country, we fell foul of everyone and missed the peaks of the flight seasons in most areas. A common criticism described the count period as coming after the spring butterflies' appearance and prior to that of high summer species. Obviously the dates will have to be altered, but hopefully without losing the corporate focus on one count period. The May, 1976 number of Atala (or an earlier mailing) will carry an announcement of the revised procedure. We can say for sure that the next Count will permit much greater flexibility in planning the date of your count.

Although several counts took place on already reserved or protected habitats, few reports commented on the safety of the habitat covered from development or other changes. One of the chief purposes of the Count is to engender awareness of the habitat conservation situation in the chosen area. Therefore, I hope that future counters will place a greater emphasis on this vital aspect.

The benefits of the Xerces Society Butterfly Count in monitoring populations can only accrue if the counts are repeated annually. We urge this year's participants to join in next year again, and those who were unable to make it in 1975 to join or organize a local count in 1976. My thanks to all who helped make this first count a success. Sally Pyle

* *

(abundance rating reiterated: 1=1 sighting/capture; 2=2-5; 3=6-20; 4=21-100; 5=more than 100 encounters.)

ZONE I, SOUTHWEST.

(California)

Berkeley, CA. 37° 52' N, 122° 15' W (all points within a 15-mile diameter circle, centered on University of California campus camponile; circle includes Yerba Buena Island, bayshore from Pt. Richmond to south Alameda; Berkeley Hills SE to lower Redwood Canyon; Sobrante Ridge and Pinole Creek; San Pablo, Briones and Lafayette Reservoirs. Habitats: approx. 15% open bay, 6% brackish marsh and mudflat, 40% residential, 10 % industrial, 30% oak-laurel forest, chaparral and pastoral hills, 4% fresh water lakes). July 5, 0900 to 1730 PDT. Clear, 60-85° F. wind SW to NW 0-15 mph. Five observers, 2 principal and 3 casual in five parties. Total party hours, 18 (15.5 on foot, 2.5 by car); total party miles, 102.5 (8.5 on foot, 94 by car). H. phyleus 3, P. melane 4, O. sylvanoides 1, O. agricola 3, P. sabuleti 2, P. communis 3, E. tristis 3, B. philenor 4 (larvae numerous), P. zelicaon 4 (+ 1 egg), P. rutulus 3, P. napi 1, P. rapae 5(+ eggs, larvae), C. eurytheme 2, E. ausonides 1, S. melinus 1, L. xanthoides 3, P. acmon 4, P. enoptes 2, C. argiolus 3, L. lorquini 2, L. bredowii 3, V. atalanta 2, C. virginiensis 2 (+ 2 larvae), C. annabella 3 (+ 1 larva), J. coenia 4, N. californica 1, N. antiopa 1, P. satyrus 2, P. mylitta 3, P. campestris 3, E. chalcedona 4, S. coronis 2, D. plexippus 1, C. californica 4, C. pegala 4. Total: 39 species, c. 600 individuals. Butterfly species seen in area during count period but not on count day: none. Moth species observed on count day: Caenurgina erechtea 3, Phryganidea californica 5, Perizoma custodiata 3, Pyrausta subsequalis 3, Dicymolomia metalliferalis 4, Rotruda mucidellum 1, Oidamatophorus monodactylus 1, Epinotia emarginana 1, Chionodes chrysopyla 4. Observers: C. D. MacNeill, P. A. Opler, J. A. Powell (compiler-201 Wellman Hall, UC, Berkeley, CA. 94720) E. J. Rogers, P. A. Ride.

Woodbridge, San Joaquin Co., CA. (All locations within a 3-mile radius from Woodbridge: (A) 3 mi. east of Woodbridge on north bank of Mokelumne River(sec. 32T4NR7E-baseline M). Richly vegetated, trees, shrubs, native and introduced herbs and grasses; vineyard and winery nearby; several settling ponds, some dry with lush meadow-like growth. Visited from 0900 to 1200 PDT. Clear, 70-80° F. 4 miles of river bank, railroad and dirt roads walked. (B) 2 mi. east of Woodbridge on north bank of Mokelumne River (sec. 31T4NR7E). A less diverse area, w/ much less flowering vegetation; frequently used swimming place. Visited from 1230 to 1315 Clear, 80-85°F. 1 mi. river bank and dirt road walked. (C) Eastern edge of Woodbridge on southwest bank of Mokelumne River (sec. 34T4NR6E). A dry, weedy levee and 1-acre vacant lot. Visited from 1330 to 1400. Clear, 85-90°F. About 1/4 mi. walked. (D) 3 mi. south of Woodbridge on east side of Lower Sacramento Road across from Happyholme Farms (sec. 15T3NR6E). Unsprayed alfalfa field with clover and plantain. Visited from 1415 to 1500. Clear, 90-95°F. About 1/4 mi. walked. July 11. Four observers. Total miles on foot, 5 1/2. *P. melane A1, O. sylvanoides A1 B1, *O. yuma A2 B1, A. campestris A1 B1, *P. sabuleti A1 C1, H. phyleus A1 B2, P. catullus A2 B2 C4, P. communis A3 B2 C3,

*COUNTY RECORD

E. tristis A2, H. ericetorum B1, B. philenor A2, P. rutulus A1, P. rapae A5 B5C5 D5, C. eurytheme A1, D4, *S. sylvinus A2 B1, S. melinus D1, L. helloides A4 B2 C2 D2, P. acmon A2, *E. comyntas A4 B3, L. lorquini A1, V. atalanta A2, C. cardui A1, C. annabella A1, J. coenia A2 B2, P. satyrus A1, P. mylitta A2, D. plexippus A1(larva). Total: 27 species. Observers: Kirby M. Brown (compiler S. J. Co. Dept. of Agric., Box 1809, Stockton, CA, 95201) Thomas Farr, Carolyn Harkness, Robert Langston.

ZONE II, NORTHWEST.

(Washington)

Big Soos Green River, King Co., WA. 47°22'N 122°8'W, **centered on barn at Big Soos Butterfly Reserve, 26445 - 156th** Place SE, Kent. Habitats within circle include varied agricultural and meadow lowlands on the Green River flood plain south of metropolitan Seattle, rapidly becoming developed for industrial and commercial uses; Puget Sound Trough and Cascade Mtn. foothills, heavily forested with conifers and with hardwood scrub in successional areas, and with many secondary clearings along power-line and railroad rights-of-way, etc; rural and semi-rural areas progressively losing ground to suburbanization. The count took place entirely on the Big Soos Butterfly Reserve, a 13-acre old farm on Big Soos Creek. Habitats visited include yard and garden, old orchard, open upland Douglas-fir woods, dry open slopes, wet meadows dominated by grasses, sedges, forbs and bracken, willow-lined creek-banks, alder swamp and reed fen, and 2 acres of old-growth spruce-cedar forest. All but the latter are lightly grazed to keep them open. July 6, 1000-1500. Clear, 70-75° F, no measurable wind. Four observers in one party. Total party hours 5 (5 on foot, 0 by car). Total party miles 2 (2 on foot, 0 by car). P. rutulus 3, L. lorquini 2, L. helloides 3, E. amyntula 1 (β), C. pseudargiolus 1 (β), P. clodius 1 β (= new Big Soos record). Total: 6 species, about 25 individuals. Butterflies seen during count period (1973) but not on count day: P. rapae, V. atalanta, C. annabella, P. satyrus, C. tullia. **Observers: H. W. Pyle, R. M. Pyle** (compiler - Sage Hall, Yale Univ., New Haven, CT **06511), S. A. Pyle, D. P. Shaw.**

Seattle, King Co., WA. 47°38'N 122°78'W, **centered on water tower in Volunteer Park. The circle is nearly tangential with the north and south city limits of Seattle,** and includes parts of Bellevue, Lake Washington and Mercer Island on the East, and Puget Sound on the West. **Habitats include both marine and fresh-water shoreline, residential, commercial and** industrial urban landscape, rights-of-way and vacant lots, and large areas of parkland consisting of landscaped lawns and gardens, secondary meadows and deep wooded ravines with virgin and old second-growth coniferous and broadleaf forest. Major localities visited were Schmitz, Alki Point, Seward, Woodland, Gasworks, Ravenna, Discovery and Carkeek Parks; **Univ. of Washington Arboretum, Green Lake, Montlake Fill and the Burke-Gilman Trail.** July 4, 0900-2000 PDT. Clear, **70-75° F, no noticeable wind. 4 observers, counting in three parties when on foot. Total party hours 27 (24 on foot, 3 by** car). Total party miles. 88 (22 on foot, 66 by car). **P. rutulus 4, P. rapae 4, L. lorquini 3. (Some twenty species had been** considered possible; we considered renaming this the **Fourth of July Slug Count, since many more of those invertebrates** were seen than butterflies, and an equal number of species.) Total: 3 species, 119 individuals. Butterflies seen during **count period but not on count day: none. Observers:** H. W. Pyle, R. M. Pyle, S. A. Pyle (compiler - Sage Hall, Yale University, New Haven, CT 06511), D. P. Shaw

Mount Rainier National Park, WA. 46°47'N 121°45'W, **centered on Louise Lake. Circle includes alpine and subalpine** country on the south side of Mt. Rainier; many habitats represented, and much of the count area is wilderness. July 3, clear, 55° - 88° F. 2 observers in one party. Total party miles 30 (5 on foot, 25 by car). N. milberti 2, B. epithore 1, E. editha 3, S. mormonia 1, S. zerene 1. Total: 5 species. At lower altitudes in Mt. Rainier Nat'l Park, P. clodius **was abundant. Observers: Carolyn Proctor, Noble Proctor** (compiler - Dept. of Biology, S. Conn. St. College New Haven, CT)

ZONE III, ROCKY MOUNTAINS.

(Colorado)

Gilpin, CO. Centered on the ghost town of Gilpin, Gilpin Co. **Circle includes many excellent and a few famous localities within** the Transition, Canadian, Hudsonian and Alpine life zones from 7,500' to 13,294' (James Peak) in Boulder, Gilpin and Clear Creek Counties, e.g. the Nederland-Eldora-Caribou circuit; the Rollinsville-Tolland-East Portal-Corona Pass region; Golden Gate State Park; portions of Clear Creek Canyon. Predict we'll be able to collect this circle for 20-50 years. 29 June, 1000-1500 MDT. Clear, high 85° F. 5 observers in two parties. (Information following abundance rating: mf=sex; condition -- +=fresh, o=medium, -=worn; * = Gilpin Co. record; locality -- A=Clear Creek Canyon, 7500', B=Stanford land (Aspen Springs nr. Dory Hill, 9000', C= Blackman Meadows Trail, 8400-8800'(Golden Gate St. Pk.), all Gilpin Co.)* T. p. pylades 1 m + B, E. icelus 2 m + B C, E. persius fredericki 2 mf + B C, E. pacuvius pacuvius 1 m + B, P. r. ruralis 2 m o- C, P. c. communis 1 f o C, O. garita 3 mf + A C, H. juba 2 m o- A, H. nevada 1 m + A, H. viridis 3 m + A, P. themistocles 1 f o A P. origenes rhena 2 m + A, P. draco 2 m + B C, E. vestris 3 mf + A, A. aenus aenus 2 m o A, *P. polyxenes 2 mf + A C, P. gothica 2 mf + B C, P. r. rutulus 3 mf + A B C, P. multicaudatus 2 m + A, P. eurymedon 2 m + A C, P. phoebus sayi 4 mf + B C, P. rapae 2 mf o- C, P. protodice 2 mf 0 C, E. ausonides coloradensis 3 mf 0- ABC, C. eurytheme 2 mf = B C, C. a. alexandra 3 m + B C, *K. lyside 1 m + C (MF), E. mexicana 3 mf +o A B C, *E. nicippe 3 mf +o A B C, N. iole 3 mf + A B C, C. apama homoperplexa 1 m + C, I. eryphon 3 mf o- B C, E. isola alce 3 mf =o B C, L. melissa melissa 2 mf 0- B C, P. saepiolus whitmeri 3 mf + B C, A. glandon rustica 1 m + B, I. icarioides lycea 2 m + C, I. acmon 1 m + C, P. enoptes ancilla 2 m + A C, G. lygdamus oro 2 m + B C, E. a. amyntula 2 m + C, C. pseudargiolus 2 mf 0- C, P. zephyrus 2 m + C, N. milberti 2 m + B C, N. antiopa 2 + C, V. atalanta rubria 3 0- A B C, C. cardui 1 m + C, P. campestris camillus 3 m + A B C, P. pallida 2 mf A C, P. arachne 1 f + C, C. gorgone carlota 2 mf 0- A, C. nycteis drusius 3 mf + C, E. anicia capella 1 m + C, S. atlantis hesperis 1 m + C, S. callippe meadi 2 mf o A C, *S. coronis halcyone 1 m + C (MF), S. edwardsii 2 m + A, S. aphrodite ethne 1 m + A, E. claudia 2 mf 0- A B C, C. tullia ochracea 4 mf + B C, O. c. chryxus 1 f o C, E. e. epipsodea 3 mf + B C. Total: 62 species. (149 spp. are known from Gilpin County, 150 might be possible on this count with more observers on an optimal day.) Observers: **Mike Fisher, Kit Stanford, "the kids", Ray E. Stanford (compiler** - 720 Fairfax St., Denver, CO 80020).

Gunnison Co., CO. 39°30'N 107°12'W, centered where **Trout Creek crosses the Kebler Pass Road, about 3 mi. SE of Marcellina Mountain summit,** in Gunnison County, Colorado. Circle chosen to include Erikson's Spring and a couple of miles downstream along Anthracite Creek at western edge (elev. 6700'), and montane sites just west of Crested Butte (elev. c. 8800' along road) at eastern edge. In future years, counting team could send people to the high peaks of the Ruby Range (Mt. Owen, 13,102') and isolated Marcellina Mountain (11,350'). This year's count was confined to roadside surveying along State Route 135, with numerous car stops along the 20 miles of unpaved country road, and finally a more extensive survey on foot of the celebrated valley sites at and just southwest of Erikson's Spring. The environment covered this year consisted largely of Quercus - Prunus - Picea pungens scrub on the dry western (Basin) slope of the Elk Mountains in the southern Colorado Rockies. July 8, 0930 - 1530 MDT. Mostly sunny (following several rainy days: this year was one of the most delayed seasons in our 20+ years of experience in Gunnison Co., with very late spring snows and cold early summer periods). Low 50's to high 80's F. Total observers 4, in one party. Total party hours, 6 (3 on foot, 3 by car); total party miles, 25 (5 on foot, 20 by car). E. icelus 3, T. nevada 3, P. draco 3, O. garita 4, P. gothica 3, P. rutulus 4, P. eurymedon 2, P. rapae 2, P. "napi" macdunnoughii 4, P. protodice 2, E. ausonides 2, C. eurytheme 3, C. eriphyle 2, L. rubidus 3, L. helloides 3, C. pseudargiolus 1, E. amyntula 2, P. saepiolus 2, I. icarioides 3, E. claudia 1, B. bellona 3, C. palla 2, C. nycteis 3, P. tharos 3, P. campestris 3, L. weidemeyerii 3, N. antiopa 2, D. plexippus 2, C. ochracea 3, E. epipsodea 4. Commentary: The designated dates for the Xerces Count are not ideal for the western U.S.A., certainly including this part of Colorado. An assay of one-week species diversity for the higher montane zone of Colorado should probably be carried out in late July or even early August, and at low altitudes the season is largely over before mid-June. In this circle, I would select 15-21 July for an annual

count. The "first seven days of July" is usually too early for most of the many fritillaries, hairstreaks and hesperiine skippers. Later in the month in other years we have regulary found, within this circle, Hesperia spp. O. sylvanoides, P. occidentalis, C. alexandra, C. scudderi, P. multicaudatus, H. crysalis, S. melinus, H. titus, S. californica, S. sylvinus, S. liparops, S. falacer, L. arota, L. heteronea, L. nivalis, A. glandon, P. enoptes, B. selene, S. leto, S. aphrodite, S. edwardsii, S. coronis, S. atlantis, S. mormonia, E. eurytion, Cynthia spp., N. milberti, C. pegala, C. oetus, N. ridingsii. In view of the late season in 1975, it was mildly surprising that we did not find E. telemachus, T. pylades, P. ruralis, P. communis, P. themistocles, I. eryphon, M. siva, G. lygdamus, B. frigga, S. callippe, O. chryxus and O. uhleri. About 15 more species can be expected as adults if higher altitudes are surveyed around 15-21 July, and larvae or eggs of several additional species can readily be found on any July date if specifically sought. This year, the most notable findings were the great abundance of P. rutulus and B. bellona and the extremely late, fresh and well marked Celastrina. Total: 31 species. Observers: M. M. Chester, T. L. Chester, C. L. Remington (compiler - Dept. of Biology, Yale University, New Haven, CT 06511), M. Svendson.

St. Joseph Co., MI. Seven sites visited: (1) Purgatory road, wet meadow w/ tall grasses (Cornus racemosa, Celtis occidentalis, Ulmus americana) bordering on Oak-hickory-maple forest, also Prunus serotina; (2) Mill Pond, open wet & dry meadow, 2 ponds, stream, Tamarack swamp, beech-maple wood, oak and Jack, Red & White pine; (3) Norton road, Tamarack-Poison sumac marsh, beech-maple-birch forest, stream; (4) Wood Lake Boy Scout Camp, beech-maple forest, Tamarack swamp; (5) Norton road II, dry meadow (Rhus typhinu, R. glabra, R. copallina); (6) Russell Ranch, marshy meadow (Potentilla fruticosa) blending to dry meadow; (7) Klinger Lake, remnant prairie (R. copallina, Baptisia spp.), adjoining wet meadow. July 5. Clear, max 80°F. 2 Observers in one party. Total party miles 17. E. conspicua 1 (site 4), E. vestris 3 (1-4), P. massosoit 4 (2-4), P. hobomok 1 (2), A. delaware 1 (3), T. lineola 2 (2, 5), Thorybes spp. 4 (2, 5, 7), E. clarus 4 (2-4), P. polyxenes 3 (3, 7), P. glaucus 1 (3), G. marcellus 2 (1, 4), P. napi 4 (3, 6), P. rapae 3(1, 2, 3, 5, 6), C. eurytheme 3 (2, 4, 5), C. philodice 3(1-3, 5-7), S. melinus 2(2, 7), S. acadica 1 (4), S. edwardsii 3 (2, 7), S. liparops 2(2, 3, 6), H. titus 2 (2, 7), L. phlaeas 3(2, 5, 6, 7), E. comyntas 3(2, 5, 7), C. pseudargiolus 1(1), A. celtis 1(1), A. clyton 1(4), L. astyanax 1(1), L. archippus 2(1), V. atalanta 4 (1-6), C. virginiensis 3(2-4), N. antiopa 2(1-4), P. interrogationis 2(1, 2), P. comma 3(1-4), P. tharos 1(4), M. nycteis 3(1, 3, 5), E. phaeton 3(3), B. bellona 2(4, 6), S. idalia 4(7), S. cybele 4(1-7), S. aphrodite 4(1-3, 6, 7), D. plexippus 3(1-7), L. eurydice 2(2), L. appalachia 3(1-4), E. mitchellii 4(2-3), E. cymela 4 (1-6), C. pegala 3(5-7). Total: 46 species. Observers: Robert Hammon (compiler - 197 E. Water St., Constantine, MI 49042), Donald Harvey. Comment: The colony of Speyeria idalia discovered on this count was significant, as the species has not been taken to my knowledge in Michigan for ten years. The remnant prairie on which it occurs will be investigated as regards its conservation status.

ZONE VI, SOUTH.
(Mississippi, Louisiana, Florida)

Lower East Pearl River, MS-LA. River flood plain with low marshy areas, higher ground with pine forest to N & NE, river levees with trees, much of river bank under water. Count area also included roadsides, wet fields with pine and Water oak, willows. 2-5 inches above normal rainfall in June; much of area flooded, therefore few nectar sources available, many roads impassable. Butterflies more abundant in September. July 4. 0600 to 1445, with rain ending count. Four observers, 140 miles by car. H. phileus mf2, P. oileus m 1, E. zarucco 3, E. clarus 1, P. polyxenes f 1, P. glaucus mf 2, P. troilus fm 1, P. palomedes m2, A. monuste mf 4, E. lisa 2, L. astyanax f 2, L. archippus 1, C. cardui 3, J. coenia mf4, P. tharos 3, A. vanillae 2, D. plexippus 2, E. hermes sosybius 2, C. pegala 3. Total: 19 species. Observers: Frank P. Fischer Jr. (compiler-2720 Octavia St., New Orleans, LA 70115), Mark P. Fischer, Lee Wilkinson, Wiley Wilksinson.

Copeland, Collier Co., FL. Taken along 14 miles of W. J. Jones Memorial Scenic Drive, which runs N from Copeland and connects with Alligator Alley (Rt 84). Center 7.4 mi N of Copeland. Dirt road through cypress swamp. July 7, clear until 1500EDT, then scattered clouds with some rain. Two observers, 14 party miles (2 on foot, 12 by car). A. numitor 1, L. accius 1, P. oileus 3, P. polyxenes asterius 2, P. cresphontes 2, P. glaucus 3, P. troilus 3, P. palomedes 4, G. marcellus 1, C. philodice 1, E. daira 2, N. iole 4, H. ceraunus antibubastus 1, M. petreus thetis, L. archippus 5, A. jatrophae guantanamo 4, C. cardui 1, J. coenia coenia 4, P. tharos 4, H. charitonius tuckeri 3, A. vanillae nigrior 2, D. plexippus 1, D. gilippus berenice 3, E. hermes sosybius 2. Total: 24 species. Observers: James C. Begg, Ada Ginsburg(compiler-710 N. Ocean Blvd. # 1102, Pompano Beach, FL 33062.

ZONE VII, NORTHEAST
(Pennsylvania, Maryland, New York, Connecticut, Massachussetts, Maine)

Central Bucks Co., PA. Center, 1 1/2 mi NE of Doylestown, 1/2 mi S of Mechanicsville, to include New Britain, Plumstedd, Buckingham and Solebury townships. Five sites visited: garden with oak and pine, field bordering orchard w/milkweed & thistle, clover field, Honey Hollow Nature Center (field w/ many wildflowers), & Peace Valley Nature Center (swamp, lake, stream & fields). July 2, 0930 - 1630 EDT, clear, 60-85°F, low humidity, wind WNW, 5-10 mph. Two observers, 40 miles total(5 on foot, 35 by car). A. logan 3, Polites spp 2, P. catullus 1, E. clarus 3, P. glaucus 1, P. rapae 5, C. eurytheme 1, C. phildice 4, V. atalanta 1, C. virginiensis 2, P. tharos 4, E. cymela 1, B. bellona ammiralis 2, S. idalia 2, S. cybele 3, D. plexippus 2. Total: 16 species. Butterflies seen during count period but not on count day: E. phaeton (3, larvae, July 1). Moths seen on count day: Physostegenia pustularia 2, Deilinea variolaria 1, Eucymatoge intestinata 1, Drasteria crassiuscula 2, Actias luna 1 (pupa). Comments: Preferred to cover smaller count area, so as to study it in more depth than larger circle would allow. Observers: Charlotte Gantz (compiler - Mechanicsville, PA 18934), Edgar Ralff.

Rhode River Count, MD. Chesapeake Bay Center for Environmental Studies (Smithsonian Institution). Marshy area, bordering river, with typical estuarine flora. Approx. 5 sq. mi. July 12, overcast w/ occasional sunshine. 20 observers (aged 14-62, mostly members of the Maryland Youth Entomology Group). P. polyxenes asterius 1, P. rapae 2, C. philodice 3, P. sennae 1, S. melinus 1, V. atalanta 1, V. cardui 2, D. plexippus 3, E. cymela 2, plus 5 other butterflies and moths not identified to spp. Total: 9 species. Observers: Phillip Keen (Asst. Project Leader), John T. Overstreet (Project Leader), Albert D. Maizels (compiler - 1835 Eye St., N.W., Washington, D.C. 20006), and 17 others.

Brinton Brook Wildlife Santuary, NY. 139 acres of meadow with pond, abundant nectar sources. July 5, clear. One observer, 1.8 miles on foot. P. origines 2, E. clarus 1, P. rapae 2, C. eurytheme 1, P. sennae eubule 3, B. selene 1, S. cybele 1, D. plexippus 1. Total: 8 species. Observer: Beatrice Ridgeway, 7 Birch Close, North Tarrytown, NY 10591.

Marsh Memorial Sanctuary, NY. Open field, 40 acres. July 6. 1000-1230 EDT. Two observers. P. hobomok 1, T. pylades 2, E. clarus 2, P. rapae 2, C. philodice 3, S. melinus 2, S. alcestis 3, L. phlaeas americana 2, V. atalanta 1, P. interrogationis 1, S. cybele & S. aphrodite 4, D. plexippus (larva) 1, E. cymela 3, C. pegala 3. Total: 15 species. Comment: Probably the two greatest factors in the decline of some Lepidoptera in this area have been spraying and the return of the forest. Observers: Alex Shoumatoff (compiler - Marsh Mem. Sanctuary, RD2, Mt. Kisco, NY 10506), Nicholas Shoumatoff.

Mt. Kisco, NY. That portion of a 7 1/2 mi radius S of Mt. Kisco comprising the Butler & Meyer Sanctuaries of The Nature Conservancy. Included within this circle are the Marsh and Westmoreland Sanctuaries, which are filing separate reports. 710 acres -- 20 meadow, 15 swamp, 3 marsh, 10 evergreen plantation, and shoreline of Byram Lake, transition zone hardwoods and hemlock stands. Elev. 450-780'. July 2, 0700-1900, clear, 70-80°F. One observer, 14 miles (6 on foot, 8 by car. P. hobomok 2, P. coras 2, P. themistocles 2, P. mystic 1, A. numitor 5, P. catullus 2, E. clarus 4, P. troilus 2, P. rapae 4 C. eurytheme 2, C. philodice 3, H. titus 2, L. phlaeas americana 3, E. comyntas 3, L. archippus 1, V. atalanta 1, C. virginiensis 1, P. tharos 3, E. phaeton 1, B. bellona 2, S. cybele 3, D. plexippus 1, L. portlandia 1, E. cymela 3, C. pegala alope 3. Total: 25 species. Observer: Martin Breen, Butler Sanctuary, Chestnut Ridge Rd., Mt. Kisco, NY 10549.

North Tarrytown, NY. Hudson River frontage at Philipse Manor Beach Club property. Milkweed, soapwort and honeysuckle in bloom, as well as cultivated garden flowers. July 6, clear and hot. One observer, 1/2 mile on foot. P. rapae 3, P. sennae eubule 2, B. selene myrina 1, D. plexippus 2, E. cymela 1. Total: 5 species, 21 individuals. Observer: B. Ridgeway.

Thornwood, NY. 2 reports. Residential areas, large gardens bounded by fields and trees, with wayside flowers. July 3, clear, warm. One observer, 1/4 mile on foot. P. polyxenes asterius 1, P. rapae 3, C. interior 1, D. plexippus 1. July 7, clear, warm. One observer. P. rapae 2, V. atalanta 1. Total: 5 species. Observer/compilers: Mary B. Trautwein (725 Old Kensico Rd, Thornwood, NY), Jean Weiss (109 Milton Rd., Thornwood, NY 10594.

Ward Pound Ridge Reservation, Crass River, NY. Area within 7-1/2 mile radius of Trailside Nature Museum. July 3. One observer. E. clarus 1, P. glaucus 1, P. rapae 1, C. philodice 1, L. helloides 1, L. phlaeas 1, Plebejiinae spp. 1, E. comyntas 1, V. atalanta 1, C. cardui 1, P. tharos 1, P. phaon 1, S. idalia 1, Euptychia spp. 1, C. pegala. Total: 15 species. Observer: David Gracer, 2222 Mark Rd., Yorktown Heights, NY 10598.

Westmoreland Sanctuary, NY. Diverse habitats within a 280 acre nature reserve. July 4, 0900-1700. One observer. P. rapae 1, A. midea 1, L. archippus 2, P. tharos 1, E. cymela 3. Total: 5 species. Observer: Anthony J, Buzzanco, Westmoreland Sanctuary Inc., Chestnut Ridge Rd., Mt. Kisco, NY 10549.

Greenwich, CT. Audubon Ecology Workshop, a 280-acre nature reserve and interpretive center. July 7, 8 observers. P. rapae 3, C. philodice 3, E. cymela 4, C. pegala 3. Total: 4 species. Observers: G. Winston Carter (compiler - 259 Glendale Drive, Bristol, CT 06010), five staff and two workshoppers.

Regina Laudis Monastery, Bethlehem, CT. Approximately one square mile. 300 acres of meadowland, cultivated gardens, orchards, woods (both coniferous and hardwood), roadsides, streams, swamps and ponds. July 4, clear, slight breeze, max. 85°F. 24 observers. A. vialis 3, E. hobomok 4, P. zabulon 2, P. coras 2, H. metea 2, H. sassacus 3, A. numitor 4, P. catullus 2, E. icelus 2, E. persius 2, E. horatius 2, E. juvenalis 2, E. clarus 3, P. polyxenes asterius 1, P. glaucus 1, P. troilus 1, P. rapae 5, C. eurytheme 5, C. philodice 5, H. titus 1, S. melinus 1, S. edwardsii 1, S. falacer 1, S. caryaevorus 1, L. phlaeas americana 2, E. comyntas 2, C. argiolus 3, V. atalanta 3, C. virginiensis 2, P. tharos 1, E. phaeton 2, S. cybele 5, S. aphrodite 2, L. portlandia 3, E. cymela 3, C. pegala 2. Total: 36 species. Butterflies seen in count period but not on count day: L. astyanax, July 15. 74 species are known from the area. Comment: Many of the hay fields had just been mowed before the count, so very little open meadow habitat was available to the butterflies. This is a definite factor in the count, I feel. The community really seemed to enjoy participation in the count. Observers: Mother Maria Nugent OSB (compiler - Regina Laudis, Bethlehem, CT 06751) and 23 nuns of Regina Laudis.

Annisquam, MA. Area of Annisquam. July 4, one observer. P. hobomok 1, P. polyxenes 1, P. glaucus 1, P. troilus 2, P. rapae 2, C. pseudargiolus 2, V. atalanta 2, L. portlandia 2, E. cymela 1. Total: 9 species. Observer: Henry T. Wiggin, Squam Rock Road, Annisquam, MA 01930.

Cape Ann, MA. Marshland, with grasses and wildflowers, many not yet in bloom. July 4, wet, cloudy, some sun, then overcast. One observer. P. polyxenes 1, P. glaucus 2, P. rapae 3, B. bellona 1, E. cymela 1. Total: 5 species. Observer: Ivy LeMon, 36 Atlantic St., Gloucester, MA 01930.

Cook's Canyon, MA. Cook's Canyon Wildlife Sanctuary. July 4. Skippers 3, P. glaucus 1, P. rapae 2, C. interior 1, V. atalanta 1, C. virginiensis 1, P. tharos 2, D. plexippus 2. Total: 8 species. Observers: Jeff List, David Miner (compiler - Wildwood Nature Center, P. O. Box 638, Barre, MA 01005), and the Wildwood Camp Group.

Newburyport, MA. Garden of 10 Dove St. July 4. One observer. P. rapae 3. Total: 1 species. Observer: Ruth Walton.

Rockport, MA. Centered on Water Tower, top of Landmark Lane. July 4, 65-85°F, 10% cloud cover at mid-day. Two observers. Skippers 2, P. glaucus 4, P. troilus 2, P. rapae 2, L. archippus 1, N. antiopa 2, C. pegala 1. Total: 8 species. Observers: Bonnie L. Lewis, Michael T. Hanlon.

Salisbury, MA. Open field, grass and flowers, bordered by oak, some pine and maple. Sunrise to sunset, July 4. Two observers. P. glaucus 3, P. rapae 4, C. interior 2, C. pseudargiolus 3, Feniseca tarquinius 1, V. atalanta 4, C. virginiensis 2, Boloria spp 2, S. cybele 2, D. plexippus 1, E. cymela 3. Total: 11 species. Comment: It really bothers me how, in the last two years, the Monarch population around heare has dropped to almost zero, when two years ago they were as common as Cabbage butterflies . . . why? (Ed. note: Populations of D. plexippus fluctuate naturally and drastically, and they are not always at the same levels from place to place. While you found them scarce in 1975, Monarchs were nearly as abundant as in 1973 along the Rhode Island and Connecticut coasts this past fall. I predict you will see a rise again in Salisbury.) Observers: Mike Reynolds (compiler - 10 Grover St., Salisbury, MA 01950) and friend Scott.

Islesboro, ME. Circle includes all of the island of Islesboro, in Penobscot Bay, Maine. This year's count covered the N end of the island, or about 1/3 of the area. Localities visited: A - Brewer's field (uncultivated meadows bounded by east bay); B - Bluff Road (dirt, c. 3/8 mi); C - Charist field (gravel pit with meadows & woods bordering); D - Ladd's field (fallow meadows, c. 1 1/2 acres; E - Roadside; F - Large deserted sandpit, woods & swamp; G - Sprague's sheep barn & meadow; H - Road side beside King land; I - Disturbed, weedy site behind Durkee Store. July 4, 0920-1320, clear, 77-87°F; calm to light wind. Four observers. Total party miles, c. 15 by car and foot. P. hobomok 2 B E H, A. numitor 1 B, P. coras 2 H, P. themistocles mf5 A-I, P. mystic mf5 A-I, P. polyxenes f1 G, P. glaucus f2 A-C, F, P. rapae m2 B F, C. interior mf4 A-I, C. philodice 2 B(f+egg), L. phlaeas americana 2 C, C. pseudargiolus mf2 A B G, L. arthemis 2 C D E, L. archippus f1 F, V. atalanta 1 A, C. virginiensis 2 A B C I, C. harrisii 3 A B C, P. tharos mf4 A-I, B. selene 2 B H, S. cybele 3 B F H, E. cymela 1 D. Total: 20 species. Butterflies seen in count period but not on count day: L. epixanthe, July 3. Moths seen during count: syntomid, 1; A. luna, 2; Haemaris spp., 1. 45 butterfly species are known from the area. Comment: The big surprise of the day was the large number of C. interior. This butterfly was very scarce here in the fifties, and has been uncommon since, seldom more than a dozen seen in any one season. I would like to suggest that a 3-day count might give a better indication of what butterflies are actually in a given area. . . having the count postponed for a week or ten days would make a great deal of difference in the numbers and possibly the species seen. A 3-day count which included at least one sunny day would provide a lot more information about numbers, habits and sexes. It would also give an opportunity to check identification, and if carried out nation-wide on the same three days it might furnish valuable insights about synchronization of weather, flora and fauna. (Ed. note: It would also prove the endurance of the counters, especially if all three days were sunny!) Observers: John Ayer, George Brewer, Jo Brewer (compiler - 300 Islington Rd., Auburndale, MA 02166), Gerald Straley.

Gaging the Countryside . . . . with Ed Gage

2: TROUBLE - SHOOTING

Many lepidopterists are becoming more aware of the significance of conserving our butterfly habitats. To be effective, this may mean anything from extensive land acquisition to protection of a small marsh. In all cases, the critical issue hinges on delicate public relations. Some parts of the country are ready for and open to contacts from conservationists; others are less so. However, in most situations at least some progress can be made in raising public awareness, and thereby preparing for future issues.

Most people still do not concern themselves greatly over butterflies or other incidental insect encounters. Perhaps this is because non-pestiferous insects go largely unnoticed in their brief but fascinating lives. When one tries to press a conservation case based solely on the fragile scaly-wings, the odds against a satisfactory outcome are all but overwhelming. The ideal situation is one in which a proposed butterfly preserve can be related closely to a peculiar habitat type, or to the lives of other unusual or rare organisms in its ecosystem. Not uncommonly, natural areas are evaluated for their vertebrate faunas. When this comes up, lepidopterists have the shining opportunity to add butterfly input. This may strengthen the case as a whole, as well as bolstering the insects' chances for survival in that particular area. The unusual juniper forest of southeastern Washington and its special population of Mitoura hairstreaks make up an example of this sort of relationship, and I will write of them in a future column. Naturally, the more diverse the flora and fauna, the more significant the outcome will be -- and the better the chances for saving a special butterfly resource.

In surveying a site for its potential as a diversified preserve, there are several factors which should be considered. First, one should not overlook even the least obviously attractive places. How many times have endangered species held out in secret enclaves very near our big cities -- secret, that is, until some sharp-eyed naturalist spied them? Besides, many of the more spectacular places have already been protected. The more subtle reserve candidates often pass from the landscape, their special wildlife virtues never having been recognized.

Second, one must attempt to understand the biology of a population or a community in order to properly evaluate their characteristics for reserve consideration. For every officially listed endangered taxon or habitat there probably exist several others, undiscovered or unevaluated, which are equally worthy of this dubious distinction. Some of these populations and communities are in their critical states due to natural successional changes, although most declines are human-related. A little biological understanding, a lot of curiosity and some clear thinking will go a long way toward elucidating natural and manipulative threats to a colony of butterflies and the environment which supports it.

Third, one will do well to apply practical biogeography to the problem at hand. Little can be done to conserve annual immigrant butterflies, over the long run; nor do ubiquitous, wandering species respond to habitat reservation and management in the same way as very local kinds. Taking this further, it should be obvious that geographically isolated areas are among the best places to check out for reserve value, as they will produce many surprises. Accessible localities will likely be either a) severely disturbed; b) already set aside, or c) rather well known regarding its wildlife make-up. Out-of-the-way and back-country places, in contrast, beg for biological recording at the same time they furnish a natural moratorium on development and change. So if you do find something worth protecting in a strange place, you may also have sufficient time margin in which to do something about it.

Remember the free and handy tools you have at your disposal for your ecological trouble-shooting: the local university herbarium, US Forest Service maps, area ecologists. The latter might direct you to a botanically unique spot which may also harbor a scarce butterfly or moth. Geologists' clues help too -- have you checked out that serpentine outcrop in the next county? When I locate such situations, I like to photograph and document them as carefully as possible. That way if they do turn out to be especially significant, I have the evidence for the conservation struggle which might well follow; or at least an intimate portrait of a special place, if it cannot be saved. Through wise trouble-shooting, let's hope it can.

ON THE WING

* Endangered Species: Proposed Rule-Makings have been published in the Federal Register to declare six California lycaenids as Endangered Species. Dr. Paul Opler of the Office of Endangered Species expects very soon to place the first American butterflies on the Federal List of Threatened and Endangered Species.
* California Oak Grove: A steady flow of information from Dr. Arthur Shapiro and William Patterson has kept Xerces informed about a West Coast situation which may be critical for a unique butterfly population. In 1973, Dr. Shapiro discovered several populations of Satyrium californica, the California Hairstreak, in the Sacramento Valley. While the species is common in the Sierra Nevada foothills nearby, where it feeds on Ceanothus, these Valley hairstreaks employ the none-too-common Valley Oak as their hostplant; they differ in several significant ways from other S. californica. Unfortunately, a proposed industrial park near the American River Parkway places what may be the last self-sustaining grove of Valley Oak near Sacramento in jeopardy -- and with it, the major colony of the Valley-endemic race of S. californica. A staunch letter-writing campaign led by Dr. Shapiro and joined by a number of XS members influenced a decision by the Sacramento City Planning Commission to deny permission to develop the oak grove, for the time being. This successful battle bought time during which XS activist Bruce Walsh will conduct a thorough survey of the Valley Oak-feeding hairstreak colonies. According to Dr. Shapiro: "Assuming the trees are not cut down in the interim, prospects for compromise still look pretty good. I was very impressed by the sensitivity of the majority of the Commission to environmental issues and the responsibility with which they exercised their mandate in this case." And we were impressed by the tenacious and informed actions of these California Xerces members. We will anticipate a full report next autumn.
* West Rock State Park: The long and frustrating movement to protect this Connecticut ridge, perhaps the richest butterfly locale in New England, finally met with apparent success when the state legislature established a new state park. Dr. Charles L. Remington of Yale University has been called upon to provide management advice on special habitats to the Department of Environmental Protection. Full satisfaction of the park's potential for butterfly conservation, however, awaits a protracted period of private land acquisition: something which cannot be expected rapidly in this fiscally sore state.

METAMORPHOSES

XS Vice-president Jo Brewer has relinquished the massive task of membership-keeping after four devoted years, turning the files over to Secretary Joan DeWind. Jo's superb efforts have been vastly appreciated, as has the enormously successful fund-raising campaign which she conducted based on sales of her limerick book. We hope she will now have time to write some more beautiful books. * The Society's first paid employee is Cynthia Augsberger, secretary to the Executive Director. Cindy, an advanced student at the Stone Business School in New Haven, comes to us courtesy of the World Wildlife Fund and the federal Work Study Program. * During his field work in Washington state last summer, the editor recruited one of Xerces' more youthful members, six-year old Shaundelle Vail of Seattle. Taken on an extended pack-trip into the Pasayten Wilderness Area by her parents Bill & Marilyn, Shaunie (wielding a net larger than herself) came out with a major contribution to our knowledge of the butterflies of that remote alpine paradise. * At 3 northern California universities, XS Members are seeking advanced knowledge of Lepidoptera biology. Bruce Walsh began studies with Prof. Arthur Shapiro at UC Davis this fall, while Larry Gall swapped hairstreaks for sulphurs to work under Prof. Ward Watt's tutelage at Stanford. Meanwhile, Larry Orsak moved on to graduate work at UC Berkeley, fitting academic pursuits around his field research on threatened butterflies of four families. Securing the inclusion of Atala in abstracting journals and speaking on insect conservation at the Lorquin Society and other venues have further occupied Larry.

OUT OF ORDER

The California Oak Grove mentioned above also harbors one of very few populations of the Elderberry Longhorn Beetle (Desmocerus californicus dimorphus). Without question, this handsome valley endemic is imperiled. * At least 5 states (MO, NC, HW, FL, OH) have initiated lists of rare & endangered arthropods for which habitat consideration should be afforded. * In Prince George's Co., MD, a lady beetle faces actual extinction from a rail project. Details will be reported in the next issue of Atala.

Atala Abstracts. A Review of Recent Literature on Insect Conservation, under the supervision of Larry Orsak, Associate Editor. As interim adjuncts to the Bibliography, first published in Atala 2(1), recent and previously overlooked papers will be summarized in each number. Suggestions, references and reprints are requested, so that this service to our readers can be maximally useful.

POLITICS and ISSUES

*Dirig, Robert and John Cryan. 1975. Endangered Pine Bush Lepidoptera. Priv. Publ., Dept. of Plant Path., Cornell U. 12 p. The biology of the Karner Blue and Buck Moth in relation to their threatened habitat near Albany, New York.

*Donahue, Julian P. 1975. A report on the 24 species of California butterflies being considered for placement on the Federal Lists of Endangered or Threatened Species. L. A. Co. Mus. Nat. Hist. 58 p. Critical habitats and ecological profiles compiled. 12 additional taxa suggested for future consideration. Recommends 7 threatened, 6 endangered spp.

*Miller, Lee D. 1975. Threatened status for two butterflies? Field Mus. Nat. Hist. Bull. 46(8): 15-22. The author rebuts federal listing as unnecessary and undesirable; discounts collecting as a threat to populations, and expresses pessemism about the potential for habitat conservation.

*Owen, D. F. 1974. Trade threats to butterflies. Oryx 12: 479-83. Without citing supportive data, the author contends that commercial collecting seriously threatens 20 British butterflies; and compares the effect of collecting tropical species with that of hunting large mammals in Africa. He calls for collecting strictures and import bans.

*Pyle, Robert Michael. 1975. Butterflies and the national parks. Nat. Parks & Conserv. Mag. 49(9): 10-14. Examines cornerstone role of US parks in habitat conservation scheme. Several endemics depend upon park enclaves. Tall Grass Prairie and other new parks urgently recommended. Park regulations should not preclude field research & collecting.

BIOGEOGRAPHY and FAUNISTICS

*Emmel, Thomas C. & John F. Emmel. 1974. A new subspecies of Euphydryas editha from the Channel Islands of California. J. Res. Lepid. 13: 131-36. E. e. insularis is known only from one colony on Santa Rosa Is.; present status uncertain.

*Masters, John H. 1975. 3 papers in J. Lepid. Soc. 29: Records of Lycaeides melissa samuelis (Lycaenidae) from Wisconsin (w/ F. H. Karpuleon; p. 31); Occurrence of Speyeria idalia (Nymphalidae) on remnant prairie in northwest Wisconsin (p. 76-77); Butterflies observed in Sieche Hollow State Park, South Dakota (p. 126-27). Each furnishes valuable new information about rare species in uncommon kinds of habitat. Strong need pointed out for conservational management of S. idalia-harboring relict prairies along railroad rights-of-way.

*Shapiro, Arthur M. 1974. 2 papers in J. Res. Lepid. 13: The butterfly fauna of the Sacramento Valley, California (p. 73-82, 115-22, 137-48); Butterflies of the Suisan Marsh, California (p. 191-206). Basic faunal studies which discriminate distinctive populations of Satyrium californica in the Valley and Phyciodes campestris in the marsh. Pacific salt marshes seem to lack the butterfly diversity of similar habitats on the East Coast.

*Tasker, R. R. 1975. A second extant colony of Pieris virginiensis in Ontario. J. Lepid. Soc. 29: 23. Habitat requirements & distribution discussed; the butterfly is endangered in Ontario.

*Wielgus, R. S. 1972 (1973). A search for Speyeria nokomis coerulescens (Holland) (Nymphalidae) in southern Arizona. An historic locality for this very rare ssp. rediscovered and the prognosis for its continued survival in face of drought is speculated upon.

ECOLOGY and MANAGEMENT

*Borch, H. & F. Schmid. 1975. The life cycle of Ornithoptera paradisea (Papilionidae). J. Lepid. Soc. 29: 1-9. See Straatman.

*Chew, Frances S. 1975. Coevolution of pierid butterflies and their cruciferous foodplants. I. The relative quality of available resources. Oecologia 20: 117-27. Colorado Pieris napi prefer certain mustards to others, as influenced by rates of larval survival and climatological factors favoring rapid development.

*D'Abrera, Bernard. 1975. The largest butterfly in the world. Wildlife 17: 560-63. See Straatman & Schmid below.

*Langston, R. L. 1974. Extended flight periods of coastal and dune butterflies in California. J. Res. Lepid. 13: 83-98. Several endangered demes figure in the coast vs. inland comparison.

*Straatman, R. & F. Schmid. 1975. Notes on the biology of Ornithoptera goliath and O. chimaera (Papilionidae). This and the above 2 papers on giant birdwings reveal life history and habitat information which could influence management of these rare and legally protected New Guinea butterflies in the wild.

*Sutton, Stephen. 1975. Forest butterflies of Zaire. Wildlife 17: 364-66. A member of a jungle entomological research team, the author stresses the need for accelerated insect studies and for rain forest nature reserves to be as large as possible.

*White, Raymond R. & Michael C. Singer. 1974. Geographical distribution of hostplant choice in Euphydryas editha. J. Lepid. Soc. 28: 103-07. Refers in part to the rare ssp. E. e. wrighti.

LETTERS to the EDITOR

to irrigate, or not to irrigate

To the Editor: Regarding radical environmental salvage, as discussed briefly in Atala 2(2): 8), my thoughts are these: The idea of attempting to preserve an environment, even a micro-environment, which is changing due to natural causes, I would equate with tilting at windmills. King Canute discovered the futility of this in the distant past; the Army Corps of Engineers rediscovers it annually along our shores and streams (unfortunately at our expense). For Xerces to advocate or undertake the reversal or delaying of gradual changes resulting from natural alterations in climate, water table, etc., would strike me as not only a waste of resources, but also as a negative advertisement of the judgement of the Society. I would hope we would concentrate our activities in a few more realistic areas which you are, of course, already advocating and pursuing: reversing, retarding or preventing human - determined changes in habitats; influencing already changed plant succession where it threatens populations depending upon seral conditions; management of power-line easements and such secondary edge habitats to promote insect diversity, and so on. Let's keep our feet on the ground! ----Dave Winter, M. D. Westwood, MA.

collecting policy

To the Editor: Please accept this card as my APPROVAL of the Xerces Society Policy on Collecting which appeared in Atala 3 (1). The well written summary suggests that the report on which it was based was thoroughly researched and all viewpoints carefully considered before any conclusions were drawn. As a result, the Xerces policy strikes a harmonious chord, blending the best of scientific, esthetic, ethical and rational notes. In these days of strident emotionalism, which results in so much discord, it was a nice sound to hear. You have my full support. ---- Boyce A. Drummond III, University of Florida, Gainesville, FL.

To the Editor: Must confess that I came extremely close to resigning when I read in Self-Help Sheet #3 that XS is emphatically not opposed to collecting. Impression given was that XS was emphatically devoted to collecting butterflies. However, there is to be a referendum (good) so I shan't resign yet. I agree that in most cases habitat loss is the biggest danger to populations... However, this is not the point. We are not arguing a purely scientific point of population dynamics. We are talking about the ethical values of unnecessarily taking the lives of beautiful living creatures, and here the opinion of the scientist is no better whatever than anyone else's. Scientists can argue themselves blue in the face about the relative effects of habitat loss, pesticides and collecting; but their scientific arguments, however learned, have no weight whatever in ethical values. Basically, what the collectors are saying is this: How can I continue my basically destructive and acquisitive activity and at the same time create an image that I am very learned and doing great things for conservation? Answer: Give learned discourses about how habitat loss is the major danger to populations and that collecting does not harm populations, and then explain to everyone that I collect wisely and judiciously, with care and restraint. That then is one reason for not accepting your proposed policy on collecting -- you have neglected the aesthetic and ethical aspects, and have assumed that since collecting does not harm the population (a challengeable premise anyway), that's the end of the argument. A second reason is this: Your policy, instead of taking a moderate line such as that collecting should only be done with a definite purpose and not for mere acquisitiveness, you have taken an extremist, fanatical hard-line stand... that is very liable to alienate moderates such as myself. (Re. Point 8 in policy)... Rubbish! I will not be told that I should respect the freedom of butterfly collectors to kill butterflies, any more than I should respect the freedom of anyone to engage in any other type of objectionable activity. (Re. Point 7)... outrageous... it will evidently be necessary to press for legislation to protect butterflies from the menace of the Xerces Society.
----Jeremy B. Tatum, University of Victoria, BC, Canada

(editor's reply on page 45.)

To the Editor: The proposed policy on collecting makes sense and is a good foundation for the future. I support it. ----David M. Stokes, Arvida, Quebec, Canada

A BONANZA OF BUTTERFLY BOOKS

BOOKS

Book Reviews by Robert Michael Pyle

The Butterflies of North America. 1975. William H. Howe (Ed.) & 21 specialists. Doubleday, NY. 97 color plates (2093 illustrations) + 32 figures. xiii+633 pp. $39.95.

Butterflies. Their world, their life cycle, their behavior. 1975. Thomas C. Emmel. Alfred A. Knopf, NY. 317 color photographs. 245 pp. + appendices. $35.00.

The Dictionary of Butterflies and Moths, In Color. 1975. Allan Watson, Paul E. S. Whalley. Introduction by W. Donald Duckworth. McGraw-Hill, NY. 405 color plates. xiv+296 pp. $29.95 until 5/31/76, then $39.95.

A naturalist I know, perusing a rich library shelf of Victorian and earlier natural histories, many of them hand-tinted, lamented the paucity of modern butterfly publishing efforts which are at once informative, curious and elegant. Upon viewing this fall's offerings from major publishers, I would expect this friend to recant. I do not remember a single season which has yielded so many Christmas entries to the butterfly book market. At the outset, I should state my belief that, regardless of the technical merits of these three kaleidoscopes, the sum of their individual glories can only be a vastly inflated public awareness and appreciation of butterflies. So this is a good glut. That said, I am far from satisfied with the books. Detailed reviews of each have or will be published in the New York Times Review of Books, Smithsonian, News and Journal of the Lepidopterists' Society and other serials. In this small space, then, I will not attempt to thoroughly interpret or criticize them, but rather to tease out some specific aspects which relate particularly to Xerces Society interests.

The seemingly forever-awaited Howe book will, perforce, replace Holland's Butterfly Book (1898, revised 1931) as the standard American reference for decades to come. Such is the publishers' intention (Doubleday did Holland, too), and such will be the inclination of everyone who wants all the species, illustrated, under one cover. As such, its publication is a major event, and our many members who have been begging for such a book will join me in congratulating Mr. Howe on the publication of his momentous work. Even if another lek of lepidopterists could be cajoled to revise or re-write the text after some years, I doubt that anyone will touch Bill Howe's superb and multitudinous paintings for a very long time. Even if it were only a vehicle for his illustrations, this expensive book would justify both its printing and its purchase. Mr. Howe is both the supreme American butterfly illustrator and a fine artist, in the sense that Roger Tory Peterson is both those things toward birds. His book is a grand accomplishment, artistically. But, of course, it is more than a showcase. A score of recognized authorities contributed to the text. The quality of scientific treatment is, therefore, quite high. However, such diverse authorship has synthisized a text of exceeding unevenness. While some authors stress natural history, others barely comment; indeed, many species accounts would suggest that next to nothing has been learned in the half-century since Holland was updated, while others introduce bushels of valuable new information from the field and the laboratory. A few of the authors are real writers (though perhaps none quite as good as Harry Clench, who wrote the very digestible introduction), while others are clearly more comfortable with a net than a typewriter. The nomenclature, while unspeakably better than Holland would be for use today, seems rather odd in places due to substantial differences in concept among authors. On the whole, however, most butterfly enthusiasts will be very glad for the book, only wishing they had had it for the first Fourth of July Count.

Yet Butterflies of North America contains one enormous omission which cannot so easily be balanced against relative strengths elsewhere. It is a profound gap and a major flaw in the design of the volume. I was appalled and dismayed, after several hopeful searches (fading into desperate page-flipping, then disbelief) to find almost no mention whatever of butterfly conservation. The single paragraph on page 57 entitled "Conservation" deals solely with "game hog" collectors; it is well intentioned, but entirely inadequate. Otherwise, aside from brief documentation of known extinctions in the species accounts, the subject is ignored. So is population biology, incomprehensibly overlooked in the introduction, where it might (and should) have been reviewed much in the way that biogeography was treated by Harry Clench. The book is practically pre-ecology in its context. In fact, Howe leaps halfway back to Holland by ignoring environmental aspects: even in 1951, Dr. Klots put forth a conservation credo in his Field Guide. If my distress seems exaggerated, it is because of the immensity of the lost opportunity. This book will be the standard home and library manual for generations of curious young naturalists seeking help with butterflies. That these open and enthusiastic searchers will not find a pathway to environmental awareness through this book, nor access to any means of conserving their catching/watching grounds, is genuinely tragic. Insect conservation depends mightily on the awareness of lepidopterists and enthusiasts, an awareness which Howe could have given to thousands. As coordinating editor he had the chance, and the responsibility for the breach must lie with him; but it is even more surprising in view of the fact that fully half of the authors belong to the Xerces Society and espouse its goals. Did they ever see the full text prior to publication? I doubt it. As a result, my view of the entire book is rather jaundiced. We can only appeal to the editor and the publishers to include a section on habitat conservation, and a notice about the Xerces Society and its aims (such as did appear for the Lepidopterists' Society and the Lepidoptera Research Foundation) in the next printing.

The same complaint goes in half measure for Xerces Member Tom Emmel's book. In Butterflies, Dr. Emmel in fact addresses threats to butterfly populations in a section entitled "Butterflies and Man." In recounting the classic story of the extinction and reintroduction of Lycaena dispar in England, the author attributes the loss to market collecting; it has been well established, in fact, that the eradication of the Large Copper came about from the draining of the Fens, with a possible late assist from collectors. Later, Emmel places what I consider over-emphasis on commercial collecting and pesticides, while referring very little to physical disruption of the habitat. At least conservation is discussed here. Disappointingly, however, the discussion ends with 2/3 of the page blank and no mention of programs to counteract the ills just described: the reader is aroused, then dropped cold with no hint that anything is "being done about it." Dr. Emmel has told me that a substantial section on the Xerces Society was axed by the editors. He is trying to have it printed and inserted in remaining stock. This is important for two reasons: First, as a Book of the Month Club alternate choice (which was also featured on a page of Time magazine) this enormously attractive book will reach a great many potentially concerned people. Second, since Butterflies is an expensive, exhibit format book, it is bound to be bought by affluent persons who might wish to contribute to the conservation of the glorious creatures therein depicted -- if they only know how.

And such depiction! Butterflies may well be the single most exquisitely visual treatment of Rhopalocera ever produced. I thought I had done fairly well in obtaining decent, natural color photographs of Washington butterflies for my book on the subject; in viewing the splendor of these pages, I am shamed. Virtually perfect, unmanipulated color portraits of hundreds of magnificent live butterflies in their natural habitats, by many photographers, display a vast new store of talent and technology in butterfly photography. The Italian printing is faultless, the layout attractive -- beginning with a climactic life cycle sequence of the Baltimore Checkerspot which fills ten pages. The text is not faultless, but the field is huge and the emphases agreeable. I found most of the writing quite engaging. Emmel is a tremendously active field lepidopterist and a naturalist, and this shows. His historical and eco-geographical essays, unique among butterfly books, read well and educate as they richly accompany the plates. Through his own experiences and a sensitive selection of quotations from others (such as Vladimir Nabokov and F. Martin Brown) the author conveys the mystique and qualities of both butterflies and the earth-tissues which support them. He writes that he hopes to get across the "unalloyed pleasure" he has found in butterflies. In this he succeeds.

Whether painted or photographed, and no matter how deployed on the page, butterflies retain their baroque beauty. The final component of this lepidopteran triptych, Dictionary brings in the additional dimension of moths. While there are more pinned and fewer live specimens in this than in the previous book, the captivating selection of wild moth photos makes up. By now used to a barage of butterfly color, one views these Nachtfaltern with a renewed sense of surprise at the sheer loveliness of the greens and the pinks and the thousands of browns borne only by moths.

The dictionary style of this basically British book is not just a gimmick to set it apart from the rest of the entries in the field.

[illegible]

Letters to the Editor. Continued: Editor's reply concerning collecting policy.

[illegible]

[illegible] ly write something for a future issue... ---- Ray E. Stanford, M. D., Denver, [illegible]

[illegible]

NOTICES

[illegible]

RESEARCH REQUEST: WANTED - [illegible] Reply to Dr. Albert Maizels, 1835 Eye St., N. W., Suite 504, Washington, D. C. 20006.

[illegible] P. O. Box 77224, [illegible]

[illegible]

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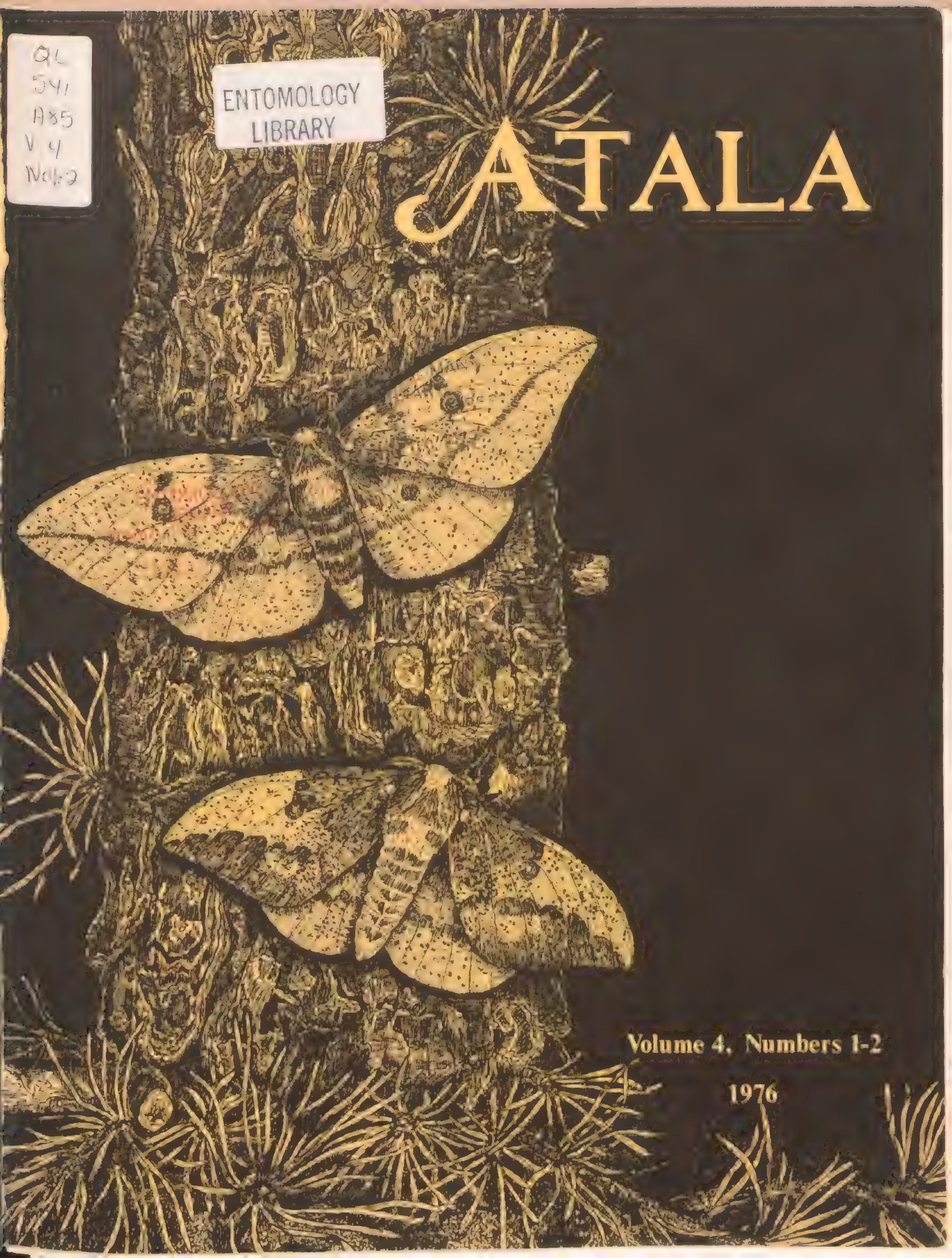
of a few caterpillars

The Xerces Society

conserving rare insect habitats.

ATALA



Volume 4, Numbers 1-2

1976

THE XERCES SOCIETY

An international, non-profit organization dedicated to the conservation of terrestrial arthropods and their habitats. Named for the extinct Xerces Blue Butterfly, *Glaucopsyche xerces* (Boisduval). Founded on 9 December 1971.

MEMBERSHIP INFORMATION

Membership in the Xerces Society is open to all interested persons and institutions upon submission of appropriate dues. Adult memberships and institutional subscriptions are US $5.00 and student memberships are US $2.50, for the 1977 calendar year. All members and institutional subscribers receive the journal *Atala* twice yearly; the less formal newsletter *Wings* three times yearly; *Self-Help Sheets* (informal, popular, how-to articles) irregularly, as they are issued; and Society meeting announcements, membership lists, and other communications. Xerces Society publication and administration costs are covered by dues and contributions, which are tax-deductible. A person or institution interested in receiving Xerces Society publications should submit name, address, and appropriate dues to the Treasurer, *Roger Pasquier, 235 East 73rd Street, New York, New York 10021, USA.*

Changes of address, back issues of all publications, and general correspondence about the Society should be sent to the Secretary, *Joan M. DeWind, Briggs Hill Road, Sherman, Connecticut 06784, USA.* Correspondence about terrestrial arthropod conservation issues, Xerces Society policies, suggestions for *Self-Help Sheets*, and *Atala* contributions should be mailed to the Acting Executive Director, *Robert Dirig, 807 East State Street, Ithaca, New York 14850, USA.* Less formal items for inclusion in *Wings* should be addressed to the Editor, *John F. Cryan, 807 East State Street, Ithaca, New York 14850, USA.* Contributions, questions, or comments about the 1977 Fourth of July Butterfly Count should go to the Butterfly Count Coordinator, *Mary Hathaway, P. O. Box 123, Durham, New Hampshire 03824, USA.*

Published at Ithaca, New York, USA, in May, 1977.

ATALA

JOURNAL OF THE XERCES SOCIETY

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Commentary

Presidential Message

Robert Michael Pyle

1, Toll Bar Cottages, Burley-on-the-Hill, Oakham, Rutland, Leicestershire, LE15 7SX, ENGLAND

This issue of *Atala* marks the fifth birthday of the Xerces Society. The idea for the Society originated on 9 December 1971, on British Rail between London and Huntingdon. That night I was full of enthusiasm for the British butterfly conservation movement, and I was anxious to provide a fulcrum for similar efforts in North America and elsewhere. Thereby, the Xerces Society came to be. But just what has it come to be, five years later?

Clearly, in our first half-decade, we have not become the pivotal force in world habitat conservation. On the other hand, we have become rather firmly established in our small corner of the conservation movement, and we have demonstrably made a difference in the course of events. I would like to take this opportunity to assess our status.

First, a word is due about the tardiness of this journal. We had hoped to adhere to a reasonably rigid schedule of publication, and in that we have failed. Tight deadlines are one thing for a journal produced by a full, paid staff; they are quite another for an entirely voluntary body made up of individuals who each have other concerns and demands. I have produced the last several issues of *Atala* at Yale University while completing my doctorate, necessarily with little help from others. This meant writing part of the copy (fortunately a diminishing amount, as good manuscripts began to come in), editing the whole, and typing photo-ready copy of the entire issue; then collating, folding, stapling, packing, addressing, stamping, zip code-sorting, and mailing the lot. It must be said in gratitude that these issues would not have been published without the help of the writers and artists, the painstaking services of Dwight Hall Press, and the labor of Sally Hughes. But the effort was intense, and it became clear that it would have to be at least partly delegated, particularly since I was leaving Yale and becoming, for a time, "of no fixed abode."

During the following peripatetic summer and autumn, production of *Atala* was not feasible for me. Then before I left the United States, Robert Dirig, Larry Orsak, and I held a very useful meeting in New Haven, Connecticut, during which we decided to allocate the duties for the creation of the overdue issues among ourselves. We decided subsequently to make it a double issue, both to get back on schedule and to mark the fifth anniversary. We think it contains some excellent and thought-provoking material, which we hope you will find interesting and useful. In the future, we hope earnestly to return to the proper publication schedule for *Atala,* which will mean the appearance of Volume 5, Number 1 in early summer.

Turning to our other regular publication, the newsletter *Wings,* we have a change to report. After creating a delightful and prompt succession of issues for several years, Jo Brewer has left that job to take on editorship of the *News of the Lepidopterists' Society*. In her place as editor of *Wings* is John F. Cryan, who has generously offered his time for that task. John is also Graphics Editor of *Atala*.

So, with the editorial position for the newsletter filled so admirably, and the duties of *Atala* dispersed among four people, I predict a satisfying resumption of Xerces Society publishing. Thank you for your forbearance during the interstice.

Besides printing the news and findings of insect conservation, what have we done in five years to justify our existence as a separate branch of the wildlife conservation field? Rather than fill space with a lengthy synopsis, I will refer you to past issues of *Atala* and *Wings* and to my North American review paper (Pyle, 1976), where specific instances are detailed. However, I would remind readers that the Society has, in several instances, affected management policies on the public lands, from New Hampshire to New Mexico, and from Ontario to Oregon. We have established a reasoned collecting policy which has reconciled apparently all but two of our members to a stand squarely behind habitat conservation as our primary goal. We have supported the Office of Endangered Species in gathering information for an intelligent listing of Threatened and Endangered United States butterflies, again stressing habitat conservation in our contributions. Without wishing to assume undue credit, we have aided the independent efforts of Charles Covell's Project Ponceanus and Robert Dirig's and John F. Cryan's Karner Blue Project. The Society has made research grants to Larry Orsak and Bruce Walsh for scientific surveys of butterfly populations of unknown status in California, and has received a grant for program development from the World Wildlife Fund. The Big Soos Butterfly Reserve, despite state tax legal difficulties, has nearly become a reality, and the awareness-raising Fourth of July Butterfly Count successfully took place for the second time this year. Through our two regular publications, the *Self-Help Sheet* series of how-to articles, and a ponderous amount of correspondence, we have generated and disseminated information on this under-reported field. And at three productive and enjoyable annual meetings, members have come together to exchange views and ideas, present and hear papers, and support the Society.

On the other side of the balance, I must candidly admit that the first five years have not been all that they might have been. Too many good ideas have been left stranded in files. Too many enthusiastic letters have waited too long for replies. And the United States Postal Service is not entirely to blame for the non-receipt of publications by some members. Without a doubt we have failed to utilize or direct the vital community component of our group to anything like its full habitat-saving capacity. I feel desperately that a tremendous amount of enthused energy is ticking over unused and unfocused. This must change if the Xerces Society hopes to achieve its possibilities. One can isolate the barriers to full realization of our potential quite clearly, and in the cold light of examination perhaps we will find our way around them. These barriers, as I perceive them, may be listed thus:

(1) FUNDS. Even since receiving our tax-exempt status, we

have been operating on a very low margin of expenditure, and publishing *Atala* always puts the treasury very near the red. We thank our donors and members warmly. We do, however, need more contributions to carry out our programs. At the present budget level we cannot even consider purchasing critical habitats. Potential new grant sources are being investigated.

(2) SIZE. Although the Xerces Society embraces insect conservation anywhere, most of our activities take place in North America. Unlike the British groups, we cannot expect the telephone, the automobile, and the train to bring us together frequently, and postage no longer is cheap. The scale of our operational arena provides another good reason for local activation.

(3) CENTRALIZATION. Quite obviously, too much of the business of the Society has depended on me for too long. This has not been by choice. As we begin to share out the responsibilities, perhaps a less erratic mode will come about. I am the first to admit that efficient management is no fit company for poverty and the graduate student way of life. And so I welcome this sixth year, during which I am taking a much lower profile in the affairs of the Society. I hope it will help to stimulate fresh new directions.

My absence has been necessitated by my wife's graduate work at the University of Leicester. We hope to return to employment in North America, at which time I hope to carry on working for the Society, at the Board's pleasure. In the interim, as well as teaching at the Vale of Catmose Village College and free-lance writing, I am chairing the Lepidoptera Specialist Group of the Survival Service Commission, IUCN, and resuming worthwhile contact with the British scientists working to understand and conserve rare insects. This interlude in the English countryside, with its many public footpaths, public houses, and overwintering Peacock Butterflies *(Nymphalis io* (L.)), promises to be most refreshing. I am very grateful to Robert Dirig for accepting the Board of Directors' invitation to serve as Acting Executive Director for one year. Please address Xerces Society business and *Atala* contributions to him for the time being. I will, of course, welcome any correspondence with which I may be able to help. Our addresses appear on the inside back cover.

Reflecting on the first five years, I would say that I am reasonably pleased, if not altogether satisfied, with the progress of the Xerces Society. I am convinced that for it to achieve its real potential as a catalytic, action organization, in order to save many more butterfly habitats, the Society genuinely needs a full-time, adequately paid, and professionally qualified executive officer, with a small auxiliary staff and an established office in a communications center. That is the minimum basis from which most of the successful and influential conservation groups work. Having seen the underbelly of operations in temporary, ad hoc situations for five years, I think I can state this opinion free from suspicion that we "just want to be like the others." Also, as I will not be in contention for the job thus created, I feel I can advocate this step without fear of my motives being misunderstood. Realization of this modest, but altogether necessary development may be some years away; I strongly hope that it may come about before the Society reaches its tenth anniversary, another five years hence.

The human pressures on rare terrestrial arthropods and their habitats are critical and exacerbating. If public and governmental awareness of their plight and importance has truly increased, it can be laid largely to the credit of the Xerces Society. Now we need to seize that awareness and from it build a really satisfactory framework of protected habitats. We need to give every Xerces Society member something positive to do with his or her energy and interest. Above all, we need to develop fresh and effective means of translating that enthusiasm into genuine conservation results.

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Articles

The Huleh and its Lost Aquatic Leaf Beetle

David G. Furth

Peabody Museum of Natural History, Yale University, New Haven, Connecticut 06520, USA

Abstract

Much of the biological history and literature of the Huleh Lake and Swamps in the upper Jordan (Rift) Valley of Israel is reviewed. Prior to its drainage in 1951-1959, this unique aquatic habitat supported a considerably larger fauna and flora, especially tropical (Ethiopian) species. The transitions that this aquatic habitat went through before, during, and after its drainage are mentioned. A small section of the former lake and swamps was salvaged and established as a Nature Reserve in 1959.

Subsequent to early threats of drainage, several attempts were made to survey the flora and fauna of the Huleh; only the flora was significantly studied. Consequently, the opportunity to gather biological and ecological information about much of the Huleh fauna was lost after its drainage. An example is the probable extinction of the isolated Huleh population of the semi-aquatic, primarily Euro-Siberian leaf beetle *Donacia bicolor*. The extinction of this *Donacia* population was apparently caused by the nearly complete extermination of its hostplant, *Sparganium neglectum*, as a result of the drainage. Some general biology of the genus *Donacia* is presented, along with the first record (1863) of a second species *(D. thalassina)* from the Huleh. Since 1971, the Huleh Nature Reserve has undergone rehabilitation in an attempt to restore habitat and biota closer to that existing before its drainage.

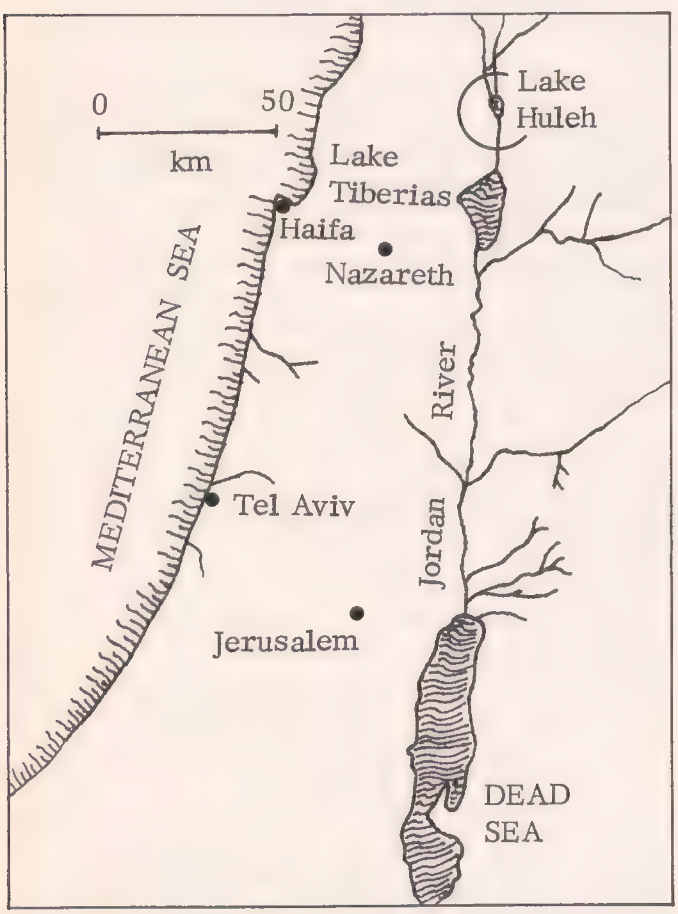

Figure 1: Jordan River System and location of Lake Huleh (after Kugler & Wool, 1968).

Introduction

In the land of the Bible existed a mysterious lake surrounded by extensive swamps known as the Waters of Merom. Aside from its Biblical mention, few travelers to the Holy Land have mentioned it and even fewer have recorded any aspects of its natural history. In more recent times, this area has been known as the Huleh (or Hula) Lake and Swamps (although "Swamps" is used throughout this paper, the Huleh wetlands were actually marshes in the technical sense). The Huleh Lake was at the head of the Jordan Valley where the major sources of the Jordan River merged (Fig. 1). It was the major part of the narrow Huleh Plain or Valley set between the eastern, high, basaltic plateau of the Golan Heights and the western, limestone, Upper Galilean mountains located in present-day Israel. The lake's surface was 67 meters (220 feet) above sea level, as opposed to its southern neighbor, Lake Tiberias (Sea of Galilee), which is 212 meters (696 feet) below sea level.

The Huleh's unique environment provided a refuge for many unusual plants and animals, including some endemics. Of special interest is the fact that the Huleh (as well as other parts of the Jordan Valley System) was and still is a refugium for a surprising number of tropical African (Ethiopian) plants and animals; this is presumably because the Jordan Valley is part of the Great Rift Valley of East Africa. The Huleh was the largest hydrophytic area in Palestine and Syria (Zohary & Orshansky, 1947). In spite of its large size and biological uniqueness, little scientific investigation took place there until relatively recently.

Why all the mystery and paucity of biological knowledge? The vast marshes surrounding Huleh Lake were so dense with various reeds, rushes, and other vegetation that most of the area was virtually impenetrable to explorers. Another major reason was the presence of the malaria mosquito in the marshes. Neither of

these reasons seemed to daunt the Jewish and Arab peasants who lived nearby. Even the Canon H. B. Tristram, in the first great biological treatise on the region (Tristram, 1884), recorded very little concerning the biota of the Huleh because he could not penetrate the area. Around the turn of the century, a few naturalists managed, with difficulty, to explore the area, and recorded details of the existing biota (Barrois, 1894; Annandale, 1913, 1915). However, it was not until the threat of drainage of the Huleh Lake and Swamps in 1934 that a series of comprehensive scientific investigations took place.

Because of the intentions to drain the area, many scientists became alarmed at the potential massive extinction of many endemic populations of exotic plant and animal species. As a result of this concern, the 1935 Percy Sladen Expedition of Lake Huleh took place. This was a small but rather intensive investigation conducted by a zoologist, R. Washbourn, and a botanist, R. F. Jones, both from England. The resulting samples were analyzed by various specialists, mostly from the British Museum of Natural History (Washbourn & Jones, 1936, 1938). Jones (1940) published the first botanical study of the Huleh, including detailed ecological information. Since this investigation, a series of studies on the fauna, flora, and physical environment of the Huleh Lake and Swamps has been carried out. Nevertheless, these studies were insufficient; in 1951, drainage plans were finalized, and the slow process was completed by 1959. Fortunately, a small section of the former Huleh Lake and Swamps was salvaged, and established as a Nature Reserve.

Below I will discuss the past extent, size, and character of the Huleh; the effects of the drainage of Huleh Lake and the surrounding wetlands on the biota; the apparent drainage-caused extinction of the isolated Huleh population of the leaf beetle *Donacia bicolor* Zschach; and the establishment of the Huleh Nature Reserve.

Past Extent, Size, and Character of the Huleh

The heart-shaped Huleh Lake covered about 15 square kilometers (6 square miles) and the swamps about 30 square kilometers (12 square miles) (Fig. 2). As mentioned above, primary inflows of water were the Jordan River source streams, as well as several springs, most notably Ein Einan (also called Wadi el Barid or Ein Melaha). The swamp area varied in size with the season, expanding during winter floods and shrinking during arid summers. Throughout the swamps were pools of various size and channels of open water, but most of the area was dominated by jungles of Papyrus *(Cyperus papyrus* L.) reaching 5 meters (16 feet) in height on peat soils, as well as *Polygonum acuminatum* Kunth, *Phragmites communis* L., and others. Sometimes the rhizomes of these plants, especially Papyrus, formed "islands" dense enough to support humans.

Jones (1940) mapped the ecological plant associations of Huleh Lake, and Zohary & Orshansky (1947) mapped the swamps. Many plant associations were present, all influenced by local ecological conditions. Many of these communities were eliminated or severely restricted after drainage of the lake and swamps (Paz, 1976). Water depth in the Huleh varied between 1 and 3 meters (3 to 10 feet), with a silt and mud bottom and basaltic pebbles on the eastern shores. The relative shallowness of

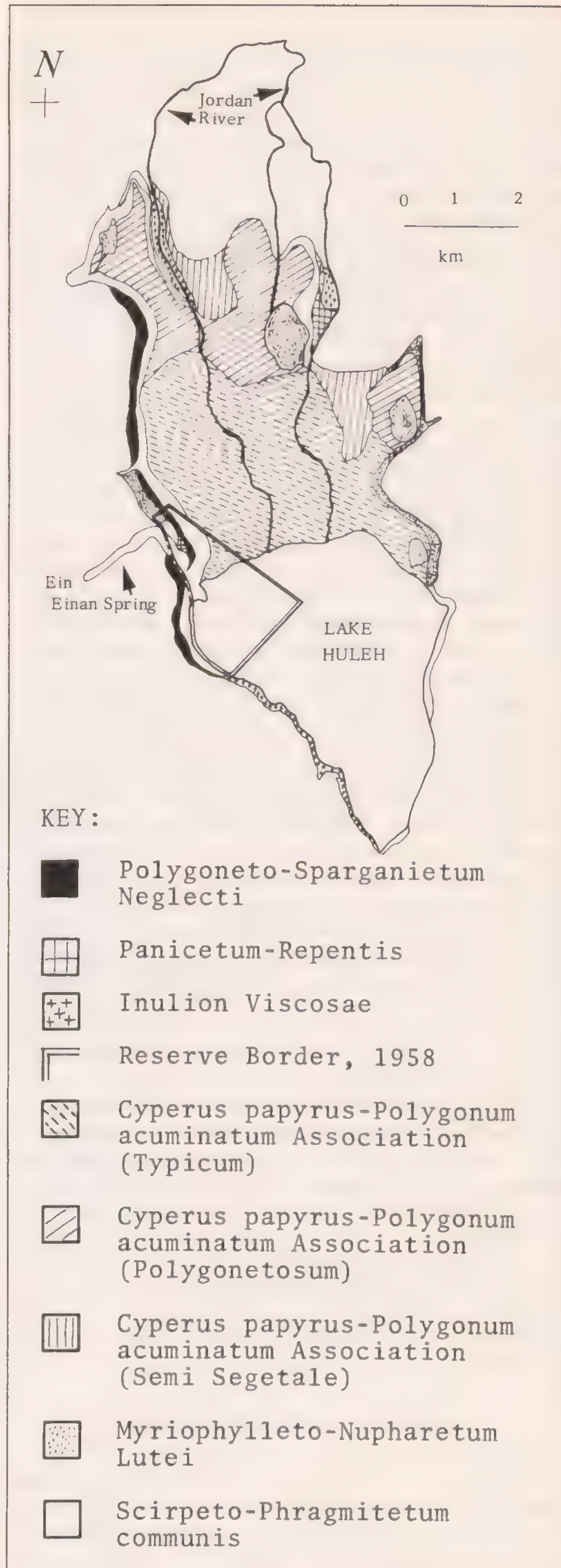

Figure 2: Huleh Swamp vegetational associations (after Zohary & Orshansky, 1947).

the lake prevented stratification into warm epilimnion and cold hypolimnion (Jones, 1940). Both the lake bottom composition and depth apparently affected the ecological plant associations (Paz, 1976). There were distinct differences in water quality between the swamps and the lake (Jones, 1940). The lake had approximately six times more oxygen than the swamps, a higher, alkaline pH of 7.9 in contrast to 7.3 in the swamps, and higher water temperature, less salinity, and less organic matter.

Those ecological factors which affected the plant associations probably also directly affected even non-phytophagous animals. Herbivores were often distributed in the Huleh according to the distribution of their foodplants. This type of relationship may have been so inflexible that when the host was endangered or eliminated, so was the herbivore.

The Huleh Valley was, and to some extent still is, the northernmost enclave for many tropical African (Ethiopian) biotic elements. In his classic work on the fauna and flora, Tristram (1884) first recorded the surprising amount of tropical African biotic elements in Palestine (comprising 30 percent of Palestinian mammals, for example). Tristram, Annandale (1913), and others claimed that no distinctly Ethiopian invertebrate elements were present in Lake Tiberias (Sea of Galilee). However, after further study, Bodenheimer (1935) demonstrated a rather high percentage of Ethiopian invertebrate species in some groups, especially insects (e.g., Orthoptera and Odonata). Ethiopian species were also found in vertebrate groups such as mammals, breeding birds, and fresh water fishes. He illustrated the unique zoogeographic position of Israel as a crossroads of various sections of the Palearctic and Ethiopian Regions. I have summarized much of the biogeographic information about Israel, including some relatively recent extinctions (Furth, 1975).

Bytinski-Salz (1961) noted that among insects, the Ethiopian species are migrants, are associated with fresh water, or are dependent on Ethiopian hostplants. These three factors probably have played and are playing an important role for many other Ethiopian animals in the Huleh Valley. The percentage of Ethiopian biota in the Jordan Valley Rift System is much higher than for Israel as a whole; examples include various species of *Acacia,* the African Monarch Butterfly *(Danaus chrysippus chrysippus* L.), and the Leopard *(Panthera pardus* L. — now endangered there). Kugler & Wool (1968) discovered that over 50 percent of the midges (Diptera: Chironomidae) in the Huleh Nature Reserve during 1965-1966 were Ethiopian elements. These included some species not found in larger Lake Tiberias which lies just to the south in the Jordan Valley and has a milder climate. There may have been even more tropical midges in the Huleh prior to its drainage; we will never know. Perhaps the two most integral elements in the pre- and post-drainage of the Huleh are tropical African species — the cichlid fishes *(Tilapia* spp.), now a mainstay in the fish industry there, and the legendary Papyrus that still dominates the Huleh Reserve. Thus the former Lake Huleh and Swamps were, and to a lesser extent still are, the northernmost locality in the Great Rift Valley for many Ethiopian species.

The Effects of Drainage on Huleh Biota

Human impact in the region was noticeable even before drainage of the Huleh. In the 13th century the Mamluks built a bridge over the narrows of the Jordan River (south of the Huleh) and this had a damming effect, raising the water level. In the early 1900's this effect was diminished when the bridge was widened

Figure 3: *Donacia bicolor* Zschach.

(Paz, 1976). Villagers around the Huleh engaged in a small fishing industry, massive harvest of Papyrus for huts or various woven products, and the domestication of large numbers of Water Buffalo *(Bubalus bubalis* L.) (Washbourn & Jones, 1938). These activities all had distinct effects on the ecology and structure of the lake and swamps, but were not nearly as damaging as the drainage during the 1950's.

Why were the Huleh Lake and Swamps drained between 1951 and 1959? The reason was two-fold: to attempt eradication of malaria, and to reclaim arable land for new settlements. The incidence of malaria was once as high as 30 percent among Jewish settlers. By 1945, due to the introduction of certain mosquito-eating fish *(Gambusia* spp.) and the extensive use of proper clothing and netting on dwellings, the malaria rate had dropped to three percent (Paz, 1976). DDT, which I have seen used indiscriminately by the Israel Ministry of Health to control malaria-bearing anopheline mosquitoes (Furth, 1969), was applied to the Huleh in 1946, and malaria cases in the region were reduced to less than one percent (Paz, 1976). It is quite possible that subsequent indiscriminate use of DDT in the Huleh may have caused eradications of other aquatic invertebrates before the drainage. It is apparent, as Paz pointed out, that malaria was actually sufficiently suppressed before the drainage commenced. Much of the land reclaimed through Huleh drainage was of little agricultural use. Thus, it appears that the drainage and its consequent prodigious reductions and extinctions of many endemic populations of plant and animal species was mostly a folly.

Effects of the Huleh drainage are too numerous to list fully here, but I will mention some of the more important ones. This paper testifies to the fact that these effects are still coming to light.

Drainage created vast areas of dried swamp vegetation (formerly inundated by water) which in 1960 ignited and burned one-third of the Huleh Reserve (Paz, 1976). Very few of the diverse hydrophytic plant associations remained, and many characteristic plants were eliminated, such as *Marsilea*, a tropical fern; *Nymphaea*, a water lily; *Utricularia*, a bladderwort, and the only carnivorous plant; *Iris;* etc. (Paz, 1976). Many plants formerly confined to discreet sections of the Huleh Valley spread over large areas, including *Tamarix, Ficus, Cyperus papyrus, Phragmites communis*, and others, which created completely new, undesirable associations.

One of the most important changes after drainage was in water quality, particularly increases in salinity, hardness, and amounts of soluble and suspended solids (Paz, 1976). This greatly affected the entirely or partially submerged vegetation, as well as the animal life. Gone were many planktonic associations and various shoreline communities and associations.

Many fish species were eliminated after drainage, leaving a very unbalanced and somewhat detrimental association. One of Israel's few endemic vertebrates, a frog *(Discoglossus nigriventer* Mendelssohn & Steinitz), described in 1940, has not been seen since 1955, and is very possibly extinct (Paz, 1976). Many species of waterfowl no longer breed in the Huleh Reserve, but still survive in other parts of Israel or in nearby commercial fish ponds (Zahavi, 1957). Other species no longer breed at all in Israel, since their habitats in the Huleh were destroyed. Mammal diversity and abundance has also been greatly altered by drainage.

Apparently little is known about effects of the drainage on the invertebrate fauna. This is largely due to lack of pre-drainage surveys and research. Among the insects, only recent study by a few specialists in appropriate groups has uncovered some evidence of possible extinctions. The Belgian odonatist H. Dumont has indicated *(in litt.)* that the subspecies of two tropical African libellulid dragonflies *(Rhyothemis semihyalina* Desj. and *Urothemis edwardsi* Selys) which occurred in the Huleh are probably extinct. A spongillafly of the order Neuroptera *(Sisyra trilobita* Flint) that parasitizes sponges is known only from the Sea of Galilee, and may now be extinct there due to recent water quality changes (J. Kugler, personal communication). Since sponges did exist in the Huleh Lake (Barrois, 1894; Washbourn & Jones, 1938), it is possible that this spongillafly was also living there; if so, it is probably extinct.

Apparent Extinction of *Donacia bicolor*

There is evidence for the extinction of the Huleh population of a semi-aquatic leaf beetle, *Donacia bicolor* Zschach (Coleoptera: Chrysomelidae: Donaciinae) (Fig.3), which is recorded from Europe to Siberia, southeast to Turkey, Caucasus, and Israel. This species was last collected in the Huleh by H. Bytinski-Salz, between March and May 1942, 1945, and 1946, on *Sparganium neglectum* Beeby. Another rather mysterious record is from the North Coastal Plain of Israel, in July 1940. These specimens are in the collections of Professor Bytinski-Salz and Tel Aviv University. Recently I discovered a specimen of *Donacia* at Harvard University's Museum of Comparative Zoology, collected in the Huleh, 1863-1864, by B. Lowne; however, this specimen was apparently correctly identified as *D. thalassina* Germer, a very close relative of *bicolor* known to occur in association with *Scirpus lacustris* L. in Europe. This is another mysterious record, and both unusual records warrant further investigation. It is quite possible that more than one species of *Donacia* existed in the Huleh at one time, since most of the worldwide genera of hosts (listed below) of all species of *Donacia* grew in the Huleh before drainage.

There have been no Huleh records of *D. bicolor* since 1946, and it seems very likely that this beetle may have become extinct (or nearly so) after the Huleh drainage. Even though no one may have been expressly searching for it during the last 30 years, its bright metallic green or coppery-green color, as well as its relatively large size (up to 11 millimeters, or about 0.5 inch) should have made it apparent were it still extant.

Donaciinae is a primitive, well known, semi-aquatic, primarily Holarctic subfamily of the leaf beetle family Chrysomelidae. *Donacia* is by far the largest genus. These beetles are of little economic importance except as minor pests of cultivated rice in parts of the Far East (Jolivet, 1972a). Their host preferences are usually rather specialized, at least to host genus; however, some feed on several hosts, whereas in others one host species may support several donaciine species (Marx, 1957). According to Hoffman (1940b) and Mohr (1966), the following host genera are known for most Holarctic *Donacia: Alisma, Baldingera, Butomus, Carex, Castalia, Eleocharis, Glyceria, Myriophyllum, Nuphar, Nymphaea, Phragmites, Pontederia, Potamogeton, Ranunculus, Sagittaria, Scirpus, Sparganium*, and *Typha*.

The larvae spend their entire existence submerged eating leaf petioles, stems, or roots. Some *Sparganium* feeders feed between two overlapping leaves. In order to feed under water they have specialized caudal spines on their dorsal side with spiracles at their bases (Leech & Chandler, 1963) (Fig. 4). This spine is used to puncture submerged plants and take air from the plant tissues through the spiracles (Jolivet, 1972a). Hoffman (1940a) also discovered that cutaneous respiration exists in the larvae. The larvae in most regions overwinter in the later instars, but in a few species, the adults overwinter (Jolivet, 1972b; and Hoffman, 1940a).

Waterproof silken cocoons for the pupae, possibly spun from oral glands or short Malpighian tubules, are placed on the punctured sites, usually near where the larvae fed (Leech & Chandler, 1963; Arnett, 1968). The pupal stage is of variable duration, but may last almost one year.

The bright, metallic-hued beetles usually feed on the exposed parts of the host, but a few species eat pollen, and some are known to spend their entire lives submerged. Adult respiration under water is accomplished by oxygen diffusion from the thin film of air captured over most of the body of the beetle by tiny hydrofuse hairs. This air film is often spread over the body by the antennae (Arnett, 1968). The adults often are rather specialized ecologically and ethologically, and often occur in somewhat

Figure 4: Larva of *Donacia* (after Peterson, 1960).

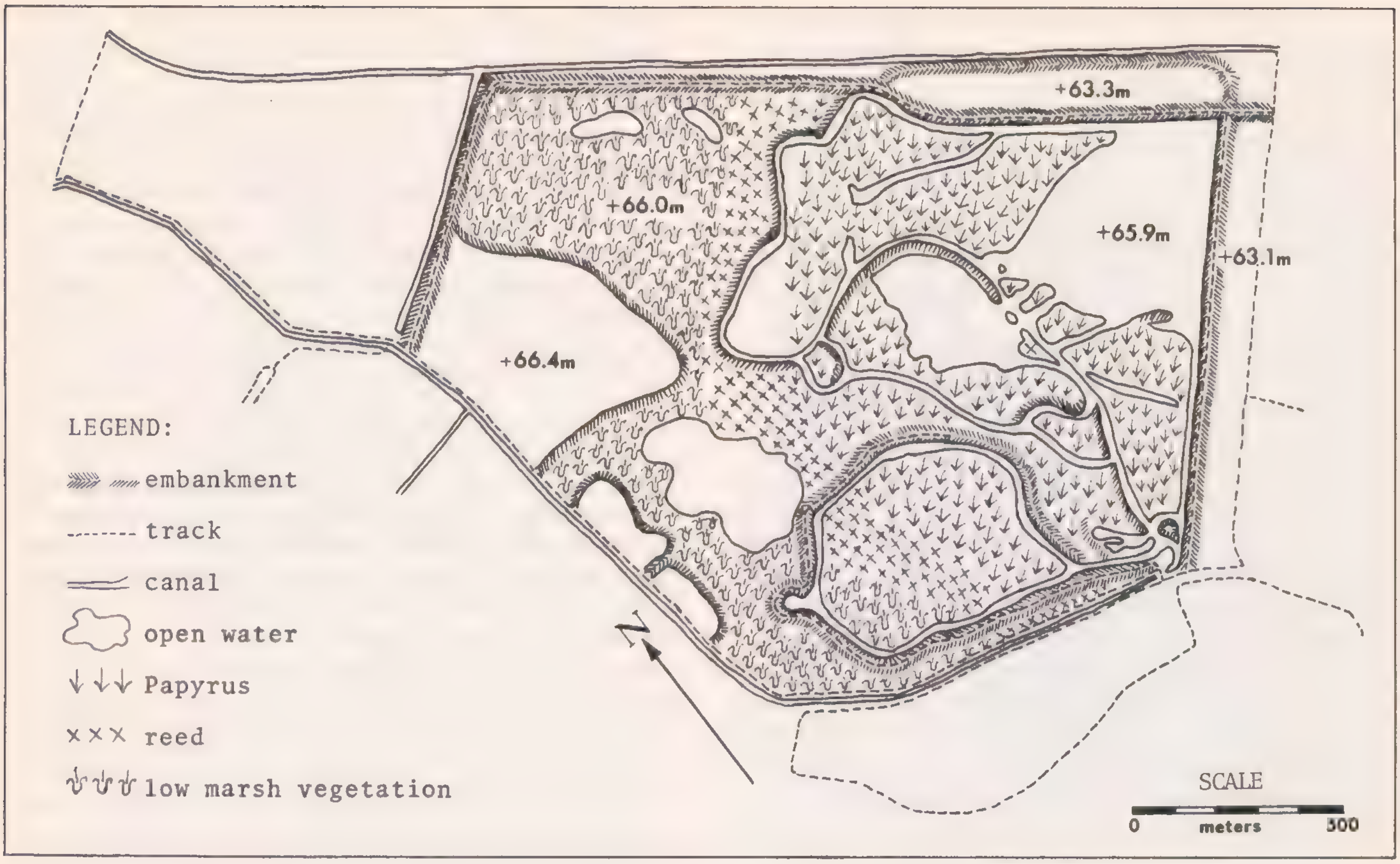

Figure 5: Huleh Nature Reserve development plan, situation after reconstruction (after Paz, 1976).

localized populations. Adults of many species of *Donacia* are known to be efficient fliers that flush easily (Marx, 1957). Eggs are deposited beneath the water surface. The life cycle may last two years in some species, and there may or may not be distinct broods present (Hoffman, 1940b). One Palearctic donaciine species breeds in fringe marine waters -- very unusual for Coleoptera (Jolivet, 1972a).

The best evidence for the local extinction of *Donacia bicolor* comes from its specialized biology and close ties with the hostplant *Sparganium neglectum*. This plant was part of a relatively small ecological plant association in the Huleh Swamps and in parts of the lake near arable land. This association extended 50-100 meters (164-328 feet) across, occurred mainly on the western and some eastern fringes of the reed *(Phragmites)* belt, and was associated with *Polygonum acuminatum* (Zohary & Orshansky, 1947) (Fig. 2). This plant is also associated with the edges of newly-formed swamps. This was one of the plant communities destroyed by Huleh drainage, and was always somewhat susceptible to dessication during the dry seasons. Paz (1976) states that *S. neglectum* is extremely rare today, found only in the Ein Einan Spring. The plant association of the Einan is that of a flowing stream; and due to differing water quality and a different environment, *D. bicolor* may not be able to exist there. I would thus conclude that the elimination of its host from the normal habitat association probably was the primary cause of the extinction of this beetle from the unique and isolated Huleh ecosystem, combined with other limiting ecological factors affecting its life stages.

Establishment of the Huleh Nature Reserve

In 1955, while drainage was still proceeding, it was agreed to set aside a certain area of the Huleh Lake and Swamps as a Huleh Nature Reserve, as a result of pressure from nature lovers and scientists. The Reserve was planned to be 4.1 square kilometers (1.6 square miles) in area (later reduced to 3.2 square kilometers or 1.2 square miles), with water more than 2 meters (7 feet) deep, and containing many boating canals. In 1964 the Huleh Nature Reserve was officially established as the first national preserve in Israel (there are currently over 100 preserves there).

The location selected for the Huleh Reserve was the northwestern corner of the former lake, an area containing the fringes of several vegetational associations of the swamps and lake. Crucial to this location was the presence of the Ein Einan Spring which provided water similar to that of the original Huleh, especially the warm temperature necessary for preservation of many tropical elements.

Putting the Huleh Reserve into operation was a difficult task due to many unexpected problems. Earth embankments created to maintain a 2-meter (7-foot) water level were improperly constructed, and much water percolated through them, significantly lowering the water level and causing dessication of preserved swamps. Attempts to alter the Ein Einan Spring for water supply caused a decreased flow, and the Reserve was initially forced to use polluted waste water from nearby fish ponds as the main water source (Paz, 1976). Problems with hunters, fishermen, fires, water quality changes, and invasions of

various escaped non-native plants made it difficult for the project to get underway. All of these problems, combined with those of the drainage, made the initial Huleh Reserve far from what was desired.

In 1971 work began on a carefully detailed plan of rehabilitation and enlargement of the Huleh Reserve. Its main objective was to recover and restock as many of the biotic associations of the former Huleh as possible. Many of the problems encountered in the beginning have been corrected to facilitate stable, controlled environments. Currently, most of the rehabilitation is completed, and several ecological associations lost after drainage have been partially reestablished (Fig. 5).

I have done a considerable amount of sweep collecting for chrysomelid beetles in and around the Huleh Reserve during 1972-1974, including the Ein Einan Spring area, without finding any *Donacia bicolor*. There is, of course, the possibility that it may persist in small numbers at Ein Einan Spring. If so, this would indicate fairly recent selective adaptation to an "unnatural environment" from ancestral stock in the Huleh Swamps. If a small population does still exist there, this beetle, along with its typical hostplant associations, might be re-introduced as a small part of the rehabilitation of the Huleh Lake and Swamps ecosystem, a fascinating part of the Jordan Rift Valley System.

Conclusion

It is encouraging to see an effort to save and rehabilitate such a special nature reserve as the Huleh; however, authorities in all preservation organizations should adopt the attitude of conserving arthropod populations and their habitats. These incredibly diverse animals are as important and enlightening as their vertebrate associates.

Acknowledgements

I would like to thank H. Bytinski-Salz, J. Kugler, and A. Freidberg, all of Tel Aviv University, for their kind assistance in gathering information for this paper. Also, thanks to Uzi Paz of the Nature Reserve Authority of Israel for providing me with a copy of his splendid work. The photograph of *Donacia bicolor* (Fig. 3) was taken by W. Sacco.

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Management Recommendations for Populations of the Bright Blue Copper Butterfly (*Lycaena heteronea clara*) of Southern California

Larry J. Orsak

Center for Pathobiology, University of California, Irvine, California 92717, USA*

Abstract

A synopsis is given of habitat, behavioral, population, and other biological studies on the Bright Blue Copper Butterfly *(Lycaena heteronea clara)* conducted in 1975-1976. Ties between the butterfly and its environment are emphasized. Methods are briefly described, and results are presented in the form of habitat management recommendations dealing with habitat modification that, if initiated, could be used to enhance the density and size of existing populations (about 30 known, in southern California). Past, present, and future threats to the localized populations are noted. The research is discussed in terms of what is required to develop management recommendations, the potential uses of such recommendations, and the probability of similar recommendations being developed for other rare, threatened, and endangered butterflies. A discussion of the benefits and liabilities of habitat modification for a rare or endangered organism is presented.

Introduction

A great many butterflies are currently on the decline, their populations negatively affected by human modification of their habitats. For the majority, the population losses to date have probably not been severe. For some, however, the decimation of favorable habitat has been so widespread and drastic that the butterflies are threatened with extinction. This may be difficult for many people to believe because the "backyard" butterflies that most people notice are both widespread and abundant. Nevertheless, the remaining populations of some butterflies are truly endangered and near extinction. What can be done to improve their situation, to increase their probability of future survival? There are two possibilities. Attempts can be made either to prevent further decline of remaining populations or to enhance the size of existing populations. The latter course might be accomplished by manipulating the remaining habitat so that it can support a larger resident population, or by creating new habitat within the natural range of the butterfly so that new populations can be started via introductions. Some degree of habitat management is necessary, regardless of the alternative. Even the attempted maintenance of some populations at present levels, in the absence of any habitat modification threats, may require such management. This is particularly true for endangered organisms inhabiting vegetational communities which are not climax communities, particularly when only a small area (not large enough to encompass a heterogeneous habitat made up of all seral stages) has been set aside.

Intelligent habitat management is simply not possible without the availability of detailed information on the biology and behavior of the organism under consideration, with emphasis on the relationships of that organism to its surrounding environment. Yet, virtually nothing is known about all of our rarer North American butterflies, except for the adult flight season, general distribution, and perhaps the larval hostplant. Thus, butterfly conservation is usually easier in theory than in practice, given our present scanty knowledge of butterfly biology. We can endlessly discuss what can be done to save populations, but until sound experiments and biological observations are made on our endangered, threatened, and rare butterflies, we will be virtually helpless to guarantee their survival, even when habitat preserves are created.

British conservationists are far ahead of their American counterparts in the assessment of habitat for rare butterflies and development of habitat management plans for these organisms. Thomas (1974) intensely studied two British hairstreak butterflies in order to determine the reasons for their rarity and decline in Britain. Likewise, Dempster *et al.* (1976) studied the habitat and hostplants of the endangered British Swallowtail *(Papilio machaon britannicus* Sietz) in an effort to explain the disappearance of this butterfly from one site and to assess the possibility of successfully reintroducing it there. Another butterfly, the Large Copper *(Lycaena dispar batava* (Oberthur)), with its one British population at Woodwalton Fen (from introduced Dutch stock), survives on habitat that has for years been artificially managed for its benefit.

It is time for American lepidopterists to follow the British example and initiate in-depth studies of our rarer butterflies. The work of Ehrlich *et al.* (1975) on the checkerspot *Euphydryas editha bayensis* Sternitzsky is an outstanding example of what can be done. Perhaps not all of this work could be carried out by casual or amateur lepidopterists, yet everyone can play a role in a research program geared toward discovering more about the distribution, biology, and behavior of any rare or endangered butterfly. Non-professional lepidopterists can make basic biological observations (patience being a requisite), and can conduct searches for previously unknown populations. Other workers can conduct the autecological work needed to develop a habitat management plan.

The basic questions which must be answered through such a diverse and in-depth research program are: (1) Why is the butterfly rare, i.e., what factors limit survival, reproduction, and colonization? (2) To what components of the habitat and environment are the butterflies particularly sensitive (taking into

*Present address: Department of Entomology, 201 Wellman Hall, University of California, Berkeley, California 94720, USA.

consideration all life stages)? (3) To what extent can the habitat be modified without adversely affecting populations of the butterfly? (4) To what extent and in what ways could the habitat be modified to enhance the population under study?

During 1975 and 1976, I investigated the biology, behavior, and habitat of a very rare southern Californian butterfly, the Bright Blue Copper *(Lycaena heteronea clara* Hy. Edwards). Almost nothing was previously known about this butterfly. My goals were to answer the questions posed above, applying the information obtained in formulating workable recommendations for remaining populations. I report here the basic setup of the program and also the more important results, presented in the format of management recommendations. Detailed methodology and results will be published elsewhere at a later date.

The Butterfly

The Bright Blue Copper was first collected in July 1876 in Tehachapi Pass (Kern County, California). The male is brilliant iridescent blue on the dorsal wing surfaces (Fig. 1A) and chalk-white beneath with scattered black spots (Fig. 1C). The female is somewhat more drab, with extensive brown and considerably less iridescent blue scaling dorsally (Fig. 1B). The ventral surfaces of the female are slightly yellower and usually with slightly more maculation than in the male.

When Emmel & Emmel (1973) was published, nothing was known of the early stages, a specific hostplant had not been documented, and the range was only generally defined. It was known that the butterfly was exceedingly local, that it flew from late June to August, and that only a few populations had been discovered (from which collectors obtained their series). I began with this scanty information and built upon it.

The Project

During 1975, a search for new populations was initiated, hostplants were determined, and basic biological and behavioral observations were made. In addition, the habitat of the Copper was qualitatively investigated, and a short-term mark-release-recapture study made at one site.

The 1976 study was more extensive and multi-faceted. High priority was placed upon describing the Bright Blue Copper habitat via vegetational mapping, and comparing the results from many populations studied. It was particularly important to identify the most crucial components of the Bright Blue Copper habitat – nectar sources, specific topographic features, perching and roosting substrates, etc. This was accomplished in part by observing the butterfly at several populations, concentrating on the behavioral and biological interactions of the organism with its environment.

Populations at three sites were studied using mark-release-recapture methods in 1976, in order that adult population size, density, life span, and general movement could be compared in different locations. Laboratory experiments were conducted to determine those environmental factors responsible for breaking egg dormancy. Larval hostplants and egg placement on the hostplant were also studied, and the life history was worked out insofar as possible.

Compared with the previous season, fewer searches for new populations were conducted in 1976. This aspect of the project was still considered important, however. First, it was essential to discover additional populations that could be compared with those already known, to determine which behavioral and biological attributes and habitat components were universally

Figure 1: Bright Blue Copper *(Lycaena heteronea clara* Hy. Edwards). A. Male, dorsal. B. Female, dorsal. C. Male, ventral.

present. Second, it is and will continue to be impossible to monitor or determine the status of any butterfly without a thorough knowledge of its range and its distribution within the range. During 1976, volunteer lepidopterists were particularly helpful in exploring for new populations. This enabled me to study various aspects of the butterfly's autecology in greater detail.

Using the information obtained in 1975 and 1976, an attempt was made to locate seemingly suitable habitats within the range of the butterfly where it did not naturally occur, so that intelligent population introduction attempts could be made. One introduction attempt was made at a site in the Tehachapi Mountains.

Habitat Management Recommendations for Populations of the Bright Blue Copper

The following summarizes data collected during the two-year study. Habitat management recommendations based on this information are included. Scientific names of California plants follow Munz (1974).

Distribution, Range, Abundance

FORMER DISTRIBUTION: Isolated populations occurred on Piute Peak (north of Tehachapi) and at Silverwood Lake (in the San Bernadino Mountains); in Antelope Canyon (Tehachapi Mountains), west to Fort Tejon; Castaic, Cuddy, and Lockwood Valleys; and at Mt. Pinos (Fig. 2).

PRESENT DISTRIBUTION: As above, but there are no recent records from the Tehachapi Mountains (the last known Tehachapi records are from the early 1930's), although further exploration is needed in the eastern portion of this area. The butterfly may also be extinct in the Silverwood Lake region, since some population sites were inundated by creation of the lake (William Klein, *in litt.*). A large classic population near Lebec (Castaic Valley) was destroyed by highway construction (from Munroe Walton Field Notebook, Los Angeles County Museum). Gravel pit operations destroyed another large population in lower Cuddy Valley (Chris Henne, *in litt.*). Some destruction at the Owl's Barn population is a result of mountain cabin construction (personal observation). There has almost certainly been undocumented population elimination in both Cuddy and Lockwood Valleys and in the Tehachapi Valley region, resulting from destruction of the natural habitat in converting sagebrush to pastureland (or farms in the Tehachapi Valley). The several populations located within or at the periphery of Frazier Park are an indication that this town may rest upon former population sites.

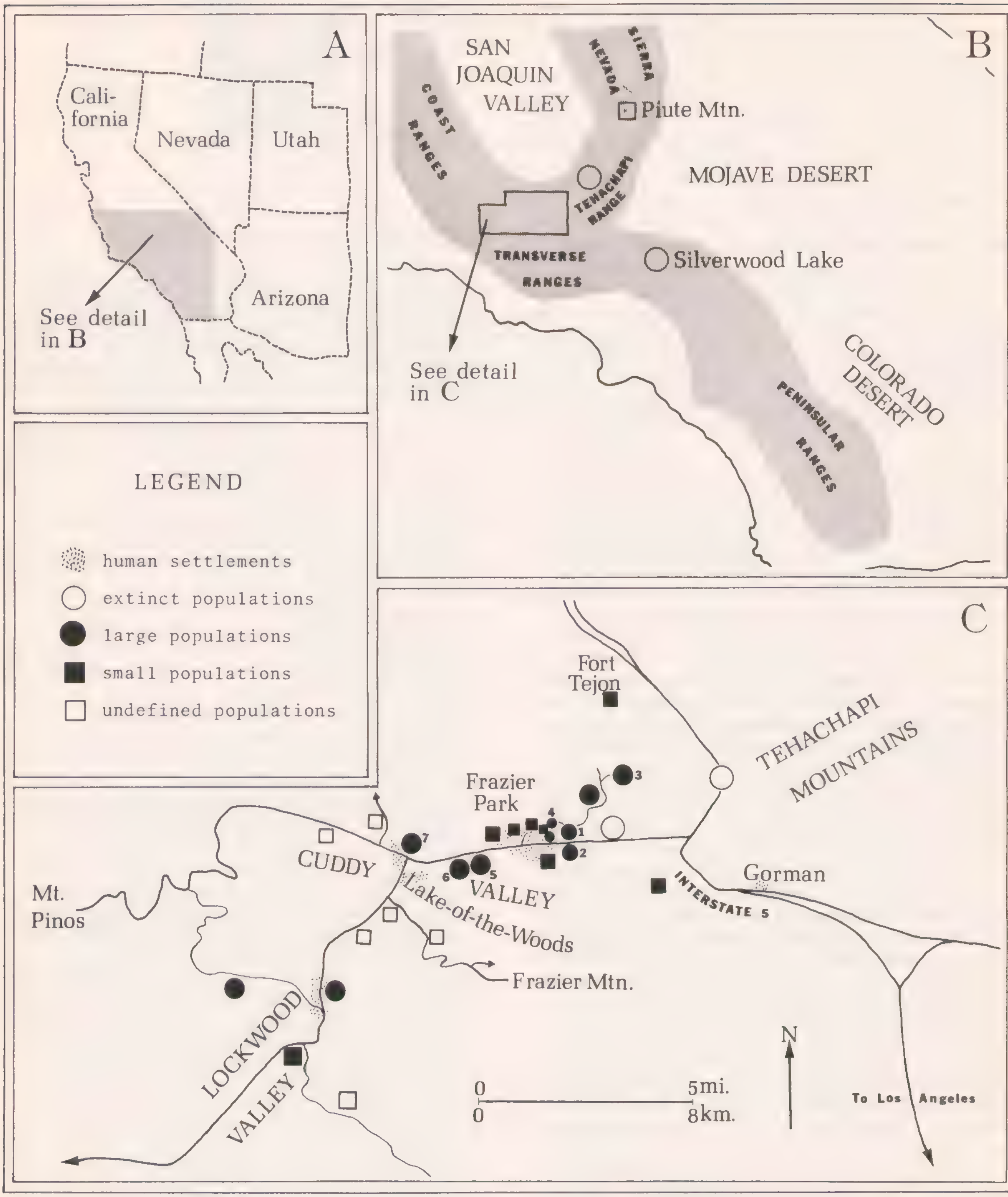

Figure 2: Range and distribution of the Bright Blue Copper. A and B. Southern California, with peripheral colony sites indicated. C. Detail of the center of distribution in the Mt. Pinos area, with colony sites indicated. In C, varying size of symbols for butterfly populations is in no way related to the size of the colony, but is due to map scale.

ABUNDANCE: The Bright Blue Copper occurs in scattered and fairly well defined populations; less than 30 are known. The butterfly is generally scarce within its range, although it may be locally common. It is "rarely represented in collections" (Emmel & Emmel, 1973).

ELEVATIONAL OCCURRENCE OF POPULATIONS: Thirty-one populations, including extinct ones, were considered. Four populations are known between 915-1220 meters (3000-4000 feet); 13 populations between 1221-1525 meters (4001-5000 feet); 11 populations between 1526-1830 meters (5001-6000 feet); and 3 between 1831-2135 meters (6001-7000 feet). The mean elevation is 1496 meters (4916 feet).

KEY POPULATIONS: By far the greatest concentration of populations is in Cuddy Valley (Fig. 2C). The two largest populations in areal size are numbers 1 and 2. Other important populations (in terms of population size) are number 3 in O'Neil Canyon; number 4 off Nat. Forest Rd. 9NO1; number 5 at Cuddy Creek; number 6 at Cuddy Creek; and number 7 at Lake-of-the-Woods.

FUTURE THREATS TO POPULATIONS: Since populations tend to be located in valleys rather than on steep hillsides, they are particularly vulnerable to human activities. Several populations are located within or directly adjacent to the community of Frazier Park, and at the present rate of development, these are likely to be destroyed in the future. Mountain cabin resorts could threaten populations in other areas. Probably the greatest large-scale habitat destruction arises from the conversion of sagebrush to pasture land. This has already extensively happened in upper Cuddy Valley. This region lies about 129-161 kilometers (80-100 miles) north of the Los Angeles metropolis, and its smog-free, rather mild climate is attracting new residents in ever-increasing numbers, including some who daily commute to Los Angeles.

Bright Blue Copper Habitat

GENERAL HABITAT AND TOPOGRAPHY: Populations are nearly always located in montane valleys, rarely on hill slopes. They usually occur in open brushy vegetation (Sagebrush Scrub of Munz, 1974), sometimes with trees, principally Pinyon Pine (*Pinus monophylla* Torr. & Frem.) or Canyon Oak (*Quercus chrysolepis* Liebm.). They rarely are found in forest clearings, in contrast to the nominate subspecies of this butterfly. Populations are always located on well drained soils in areas with adequate moisture; the Copper is almost never found on south-facing or other arid slopes. Many populations are located in or adjacent to dry, gravelly washes or gullies.

PLANT COMPOSITION OF THE HABITAT: At the Bright Blue Copper populations visited, the following three plants were generally found to be most abundant: Common Buckwheat (*Eriogonum fasciculatum* Benth., ssp. *polifolium* (Benth.) Stokes, Fig. 4C), Great Basin Sage (*Artemisia tridentata* Nutt., Fig. 3A), and Rabbitbrush (*Chrysothamnus nauseosus* (Pall.) Britton, Fig. 3B). A fourth species, Yerba Santa (*Eriodictyon crassifolium* Benth.) was the dominant plant at one population site, but was not among the three most abundant species at any other sites examined. Yucca (*Yucca whipplei* Torr.) and Mormon Tea (*Ephedra* sp.) were found in very low numbers at several population sites.

LARVAL HOSTPLANTS: Three species of wild buckwheat (Polygonaceae) are known to utilized: Heermann's Buckwheat (*Eriogonum heermannii* Dur. & Hilg., Fig. 4A), Sulphur-flowering Buckwheat (*E. umbellatum* ssp. *munzii* (Reveal) Thorne, Fig. 4B), and Common Buckwheat, Fig. 4C). Copper populations extending over the greatest area used the most widely distributed and abundant of the three, *E. fasciculatum*. In contrast, Copper populations occurring in the greatest density utilized *E. heermannii* – indeed, eggs were prefentially laid on this species, even when other buckwheat hostplants were present. Nude Buckwheat (*E. nudum* Dougl., Fig. 4D) also was found at population sites, but was not used as a host. Buckwheats functioning as hostplants were bushy in growth with rather small leaves, whereas the non-hostplant species were not bushy, but had a rosette of large succulent leaves growing close to the ground, and a flower stalk bearing a single flower or rather small clusters.

Life History

The small, white, sculptured eggs (to be described elsewhere) are nearly always placed on the ventral leaf surfaces, remaining dormant until the following spring, probably until sometime in March or April. The green, slug-like larvae generally feed on the ventral leaf surfaces, skeletonizing one side of the leaf, as do many other lycaenid larvae. Older larvae may eat entire young leaves. Pupation is on the ventral leaf surface. Adults begin emerging in late June, the peak male emergence preceding that of the females. Only a few females remain to mark the population site by early August.

Adult Behavior

Males avidly perch. Perching and roosting of both sexes is preferentially on Great Basin Sage, when this species is present, although other plants, primarily Rabbitbrush, may also be used (Fig. 3).

Some adults moved very little within the population site, others a great deal. Virtually no movement away from the site was detected in 1975 or 1976. Male movement appears to vary with the location of adults in the population. Individuals found farther from the population center are less likely to have encounters with other males (males are "territorial" and appear to move less). The presence of females is a better indicator of the breeding site than is male presence, since males tend to be encountered also in the less suitable surrounding habitat.

Population Size and Density

A study of population size was conducted at one site in 1975, using a mark-release-recapture technique modified from that

Figure 3: Adult perching substrates. A. Great Basin Sage *(Artemisia tridentata* Nutt.), with enlarged leaf at left. B. Rabbitbrush *(Chrysothamnus nauseosus* (Pall.) Britton).

Figure 4: Buckwheats. A. Heermann's Buckwheat *(Eriogonum heermannii* Dur. & Hilg.). B. Sulphur-flowering Buckwheat *(E. umbellatum* ssp. *munzii* (Reveal) Thorne). C. Common Buckwheat *(E. fasciculatum* ssp. *polifolium* (Benth.) Stokes). D. Nude Buckwheat *(E. nudum* Dougl.).

described in Ehrlich & Davidson (1960). Data were analyzed using the stochastic model of Jolly (1966). At peak flight the population numbered 290 individuals. A similar study conducted in 1976 showed that the same population numbered only 135 individuals at peak. This decrease in population size appears to be correlated with a decrease in seasonal precipitation. Maximum density at this site in 1976 was one butterfly per every 24 square meters (28 square yards). The favorable habitat there was delimited and surrounded by unfavorable habitat, making an accurate density calculation possible.

Important Known Factors Limiting or Influencing Population Location

HOSTPLANTS: Hostplant distribution is usually scattered and localized within the range of the butterfly, which in turn dictates the location of populations. Density and quality of the hostplant at each site also determine presence or absence of the butterfly.

NECTAR SOURCES: The larval hostplant *E. fasciculatum* is preferred for nectaring purposes. This blooms only once per year, at the time of adult emergence. Non-buckwheat nectar sources have been recorded, but almost always at the beginning or end of the flight season, when sufficient amounts of preferred nectar were probably unavailable.

ELEVATION: Cold temperatures (encountered at higher elevations in southern California) have been found to break egg dormancy. Although diapause is apparently broken to a limited extent in the absence of chilling, the cold, winter, mountain temperatures prevent hatching even after dormancy is actually broken. The eggs hatch rather synchronously in early spring when temperatures become sufficiently warm for embryonic development to occur. This synchronized hatching corresponds with the initiation of new growth of the hostplant; leaves can then be immediately fed upon by the newly hatched larvae.

PERCHING SUBSTRATES: In all but two known cases, populations were located in areas with heavy brush (primarily Rabbitbrush or Great Basin Sage). It is conceivable that the taller surrounding brush or trees exert a shading effect on the hostplant, inhibiting leaf dessication that would be detrimental to the larvae. The butterflies preferentially perch and roost on Great Basin Sage, probably because the adults are much better camouflaged on this plant than on Rabbitbrush and other available substrates. This may result in reduced predation (bird-pecked adults have been found). Thus, adult mortality may be lower at sites where the preferred perching substrate is common.

TOPOGRAPHIC FEATURES: None were found which directly affected the butterfly or which limit its distribution.

HIGHWAYS: The killing of adult butterflies by passing autos does not appear to exert adverse effects on the continued healthy survival of a population. The Lake-of-the-Woods population (number 7) is located on a steep hillside, adjacent to a highway. Butterflies do fly out over the road, particularly early in the season, but this situation has existed for many years, and the population remains large and healthy.

Recommendations for Habitat and Population Management

The following recommendations are made, based upon data obtained from population sites during the course of the study, and compared with similar sites not inhabited by the Copper. The

recommendations relate to habitat modifications which should result in maximum Bright Blue Copper population density.

(1) Presence of Heermann's Buckwheat as the primary larval hostplant, making up from 5 to 20 percent of the total vegetative ground cover at the site, is necessary. Higher plant densities would almost certainly give rise to increased butterfly populations, but the preferred buckwheat nectar source would also have to occur in greater density to compensate for the resulting larger adult populations.

(2) Presence of the preferred nectar source, Common Buckwheat, is necessary. This species should comprise about 5 to 15 percent of the total vegetative cover of the site.

(3) Alternate nectar sources, e.g., Deerweed (*Lotus scoparius* (Nutt.) Ottley) for early-emerging adults or *Encelia* sp. for late-emerging and end-of-season females, could be planted in low densities (probably less than 5 percent of the ground cover) in an effort to reduce mortality at either end of the adult flight season. This mortality may not be very important, particularly for early-emerging males.

(4) Presence of Great Basin Sage as the preferred perching substrate is important. Best height for plants would probably be in the range of 79 to 127 centimeters (31 to 50 inches). This plant should comprise about 15 to 20 percent of the total vegetative ground cover of the site.

(5) Trampling of the site should be minimized. While trampling does not significantly affect the individual plants used by the butterfly for nectar, egg-laying, or perching (because they are usually too tall to "trample"), it could have negative long-term implications for the population if the younger and lower-growing plants, important for continued survival of future generations of the butterfly as the older plants die, are damaged or destroyed.

(6) The smallest known area of habitat supporting a Copper population was 720 square meters (875 square feet) in size; this was in the middle of Frazier Park. Healthy populations were found to occupy habitats ranging from 1000 square meters (1200 square feet) to 1638 square meters (2000 square feet) in area. Habitat patches smaller than these could probably not support a Copper population, since significant dispersive loss was even found at the 720 square meter site. This small population will be monitored in the future to see if it can continue to survive in such a small area.

(7) Adult butterflies were never observed to fly through unsuitable habitat, such as a Pinyon Pine or oak woodland. Such a "buffer" might be established to minimize adult dispersal. It appears that populations located in a gradually changing environment tend to be more diffuse, with adults found farther from optimum habitat, than in those populations surrounded by woodlands.

(8) Larval hostplant quality appears to be of extreme importance, especially in the case of Common Buckwheat. This buckwheat is the least suitable of the three known larval hostplants, judging from its leaf size and butterfly oviposition preferences. Leaves of plants growing at locations with insufficient moisture, particularly on south-facing slopes, apparently are too dessicated to permit larval development (this is being quantified). Suitable plants were usually found growing in dry washes. Such plants probably receive adequate moisture from runoff as well as from direct precipitation during both wet and dry years, which would probably result in relatively stable butterfly populations from year to year. Both Heermann's Buckwheat and Sulphur-flowering Buckwheat have larger, more succulent leaves than Common Buckwheat, and larval survival on these species may not be as greatly affected, indirectly, by moisture fluctuations. Leaf spacing on Heermann's Buckwheat is more regular, and the leaves closer together than on Sulphur-flowering Buckwheat, where the leaves occur in clusters, each cluster rather isolated from the next. The larvae can probably move more readily from leaf to leaf on Heermann's Buckwheat, resulting in greater survival to the adult stage. Indeed, populations are much more dense at sites with Heermann's Buckwheat than at sites where Sulphur-flowering Buckwheat is present. Physiological differences in the three buckwheats, which might affect larval survival, have not been investigated.

Present Management Needs

Artificial habitat maintenance at population sites is unwarranted at the present time. The butterfly is quite rare and localized, but probably should not be considered threatened or endangered. Planting of the preferred larval hostplant, Heermann's Buckwheat, if possible, would probably enhance the size of any existing Bright Blue Copper population, particularly those where this buckwheat is presently absent.

If habitat disruption continues at the present rate, the healthy existence of the Bright Blue Copper will eventually be threatened. The United States Forest Service should act to insure the preservation of habitat for known populations occurring on federal lands. Unfortunately, many key populations inhabit privately owned property where future habitat disruption is fairly likely; this includes the largest population of which I am aware.

Habitat management would insure maximum butterfly density at remaining sites. It is doubtful that an attempt to develop new habitat would be very successful, since it is highly probable that some of the native plants, particularly those restricted in distribution (such as the preferred hostplant), may have specific edaphic and climatic requirements that limit their distribution to certain sites. Habitat management would probably have greater success in already existing favorable habitats, so that the remaining habitat could be used more efficiently for the butterfly.

Discussion

A workable and detailed set of habitat management recommendations for populations of any organism is impossible to conceive unless one has a thorough understanding of the relationships of that organism with its environment. This knowledge cannot be gained without an expenditure of both time and money. This study has been no exception. Such a task, then, is perhaps best relegated to the well funded student or professional lepidopterist, who can devote a large block of time to in-depth study. Time and money limitations unfortunately almost insure that management recommendations will only infrequently be developed, even though they would be invaluable for many rare, threatened, and endangered butterflies.

A multidisciplinary approach must be used to thoroughly study the relationships between butterfly and habitat. Butterfly distribution may be a reflection of vegetational distribution. Vegetational distribution, in turn, may be influenced or governed by climate, soil, or topography. Thus, it is invaluable to be proficient in vegetational, geological, and meteorological analyses, as well as in behavioral and other biological analyses, in order to adequately explain why a butterfly occurs in one place and not in another. It is always tempting to explain the distribution of a butterfly on the basis of larval hostplant

distribution or general habitat, but such speculation is simplistic; a complex of factors is more likely involved, coupled with biogeographic limitations.

Management recommendations are of little value unless they can be shown to work. But unless the organism in question is gravely endangered, there will be little incentive to actually test the recommendations. Data obtained on the habitat of the butterfly can be readily used, however, in locating potentially favorable sites for attempting artificial colonization. Butterflies such as the Bright Blue Copper, which are quite localized and not very dispersive, are slow to reach and colonize nearby favorable habitats which may have evolved in the meantime. Even if there is a natural colonization, there is a good chance it will be unsuccessful. Many unsuccessful natural "attempts" may be made before successful colonization is achieved. Destruction of habitat within an organism's range may further minimize the likelihood of favorable, but as yet uncolonized habitat being reached by the potential colonizing species. Hence, artificial colonization attempts, if within the normal range of the butterfly, can be legitimate, and of great benefit to rare and localized organisms.

It should be emphasized that an indiscriminate, unsophisticated approach to artificial introduction is probably a waste of time and effort; such attempts would probably be unsuccessful unless the presence or absence of the butterfly to be introduced depended only upon the presence or absence of its foodplant, an extremely unlikely possibility. There is sufficient information on the ties of the Bright Blue Copper to its environment to insure that introduction attempts would not simply involve speculation and guessing. Granted, other important but as yet undiscovered factors may limit the ability of the butterfly to survive in what appears to be favorable habitat. Even so, attempted introductions at this stage are very valuable tests of those habitat components thus far identified as requisite for the occurrence of the butterfly and its survival through many generations. If initial attempts to colonize favorable habitats are successful, present knowledge is, for the moment, probably adequate to explain the occurrence of the butterfly in specific locations within its overall range. If attempts are unsuccessful, and the site of introduction fits all the postulated criteria for habitat suitability, then additional research is obviously in order.

During 1976, I located several potentially suitable sites for the Bright Blue Copper in the Tehachapi Mountains. Since the butterfly is now apparently extinct from this region (a conclusion based on unsuccessful searches for it in 1974, 1975, and 1976), there is virtually no chance of these sites being colonized naturally. Thus, a colonization attempt was made in 1976 by releasing adults at a well defined patch of generally suitable habitat. The results of this first attempt will not be known until 1977. Hopefully, additional attempts can be made at other even more suitable sites, by introducing eggs or larvae instead of adults to eliminate the possibility of adults dispersing immediately after release, without laying any eggs. If these attempts are successful, then the research will have been worthwhile.

Any scheme involving habitat modification for the benefit of a single organism is open to criticism. There are important questions which must be considered: Is the organism declining naturally, rather than as a result of human impact on it or its habitat? Is the proposed habitat modification permanent or temporary in its effects? Is it ethical or legitimate to modify a habitat consisting of many species for the benefit of just one? Is it ethical to introduce organisms, either plants or animals, to sites where they were previously absent? We must resolve these questions, both in a general and in a specific way. For example, is it proper to try to prevent any natural extinctions? If so, should the natural extinction of the Bright Blue Copper be averted? In the following paragraphs I deal with the above questions on both levels.

Should Natural Extinctions Be Averted?

This is a philosophical question, which will never have a universally agreed-upon answer. My view is that they should not, even in the interest of maintaining diversity. By manipulating the environment in an unnatural way to prevent the natural extinction of an organism, we are tampering with nature and altering natural events to nearly as great a degree as humans often do in bringing about the unnatural extinction of other organisms. Such habitat manipulation must necessarily continue indefinitely, in order to prevent a natural decline. Are we willing and able to spend time, money, and effort which could alternately be used to halt an unnatural extinction, in our efforts to prevent a natural occurrence? There is obviously a need for priorities in endangered organism research and population management, particularly in view of the rather limited time and money resources available for such work; the prevention of natural extinctions should be of lower priority than the prevention of human-induced extinctions.

Is the Bright Blue Copper naturally declining? If the apparent natural sudden decline and extinction of the Atossa Fritillary (*Speyeria adiaste atossa* (Edwards)) (Orsak, 1974) within the Bright Blue Copper range is any indication, no. The only Bright Blue Copper population extinction known which could conceivably be attributed to natural causes is the Antelope Canyon population in the Tehachapi Mountains. The other population extinctions are easily attributed to severe habitat destruction brought about by human activities. The correlation noticed between population and precipitation fluctuation at one site during 1975 and 1976 suggests that continued drought could possibly result in the natural decline and possible elimination of remaining populations. The immediate and primary cause of population extinction up to this time, however, is human alteration and destruction of Bright Blue Copper habitat.

Should Any Habitat Modification That Is Not Permanent Be Attempted?

Of course, we must first ask whether it is legitimate to modify the habitat at all. In Great Britain, the general feeling apparently is that such modification is legitimate, even if it must be permanent. A case in point is the Large Copper at Woodwalton Fen. The hostplant of the butterfly, *Rumex hydolapathum* Huds., may be naturally displaced by other plants with time, and hence some artificial maintenance is necessary at the one British population site. In the United States, there does not seem to be much expressed opinion regarding endangered invertebrates. If habitat modification on a once-only or short-term basis can bring about enhancement of remaining populations to the point where management practices are no longer necessary, then such practices are probably well worth the time and money. On the other hand, it is inconceivable that any habitat management scheme could continue on a truly permanent basis, particularly in view of the time, money, and long-term dedication involved. It is not likely that society would condone the high costs involved, particularly for one rather small and poorly publicized butterfly.

Is the Habitat Modification Proposed for the Bright Blue Copper of a Temporary or Permanent Nature?

The answer depends upon the ability of plants introduced or artificially increased in abundance to survive and reproduce. Will they maintain themselves in a modified state? The limited distribution of Heermann's Buckwheat (and of other plants in the Bright Blue Copper habitat) might be due to an historic restriction, perhaps coupled with poor seed dispersibility; an on-going natural decline in numbers; or a narrow and specific range of environmental tolerances. Should the first possibility be the principal explanation for the plants' distributions, there would be a good chance of successful plant introductions to other Bright Blue Copper population sites, indeed, even the possible "creation" of favorable habitat. If either the second or the third possibility explains the distributions of these plants, successful introductions to new sites are unlikely. Unfortunately, there is simply not much known about factors actually limiting the distributions of plants important to the Bright Blue Copper. This further emphasizes my earlier point concerning the value and necessity of multi-disciplinary studies in wildlife management.

Is It Ethical or Legitimate To Modify a Habitat Supporting Many Species for the Benefit of One?

A value judgment is necessary here -- is it worth the potential risk of decimating or destroying populations of other organisms in order to enhance the population of one? Such a question cannot possibly be answered with a simple "yes" or "no." Instead, one must take into account the distribution and abundance of the organism that will profit from the proposed habitat modification, contrasting these data with the distribution and abundance for each of the many, many other organisms that would be affected by the habitat change in either a positive or negative manner.

How Would the Habitat Management Recommendations Proposed to Enhance Bright Blue Copper Populations Affect Other Sympatric Organisms?

Without knowing which organisms are present, an accurate impact assessment is, of course, impossible. However, the proposals given in this paper are in no way intended for widespread implementation, nor do they entail major alteration of habitat in most cases. Those plant species recommended for introduction are native, and most probably could be found growing in the vicinity of the introduction site. Recommendations pertaining to maximum ground cover for a given species usually entail increasing the density of a plant already present. Obviously, changes in the local abundance of organisms dependent on such plants will occur, but the fact that most of these plants are widespread throughout the region, if not throughout California (except for Heermann's Buckwheat -- its numbers would be definitely increased under the habitat modification recommendations), and that any proposed change would be localized, leads to the conclusion that there would be no significant detrimental effects on any other organism.

Is It Ethical To Introduce Any Organism into a Site Where It Did Not Previously Occur?

I can answer this question in part by emphasizing that I in no way advocate or approve of the introduction of any organism outside of its normal range, unless this can be achieved through the format of a well controlled experiment, having no long-term adverse effects, by a qualified scientist. Of course, the release and establishment of an organism outside of its normal range presents potential problems which must be confronted prior to the introduction. The biggest of these is that such an organism, if released from native population regulation factors such as parasites, predators, pathogens, and climatic factors, may rapidly build up and displace native species. To support this, I need only mention the weedy nature of the introduced Monterey Pine (*Pinus radiata* Don.) in Australia (a species native to a very small coastal region in California), or the majority of United States agricultural insect pests, which were accidentally introduced from other regions. Of course, not all introduced organisms would have such disastrous implications, particularly if the introduction occurred just outside the normal range of that organism. Introductions to new sites within the normal range most likely do not pose unnatural problems, particularly if the site is one which the organisms might naturally colonize in time.

Some of the problems and questions involved in saving any declining organism and in preventing the destruction of stable ecosystems lie in our tendency to maintain present conditions. Natural extinctions have always occurred and always will. Yet, it is understandably difficult to observe the decline and extinction of any organism, whether caused by natural or unnatural means. Likewise, it is hard to witness, without some chagrin, the establishment of an exotic plant which spreads, outcompeting and eliminating the native vegetation. Even so, such introductions can occur and have occurred through natural dispersal in the past, especially on islands, with a probable resultant vegetational catastrophe, until the balance between the species was, in time, restored. Oftentimes, then, human actions resemble natural events, and it is difficult to take a stand against all extinctions or against the introduction, whether natural or artificial, of any non-native organism. New species are continually evolving, and the balance of nature is restored after each natural micro-catastrophe. The difference between natural and human-induced extinctions (a very important one) is that humans have brought about the extinction of many more organisms than have evolved in a given time, and the continual introduction of exotic organisms often occurs with such rapid succession that there is constant imbalance.

In light of the above discussion, a reexamination of the Bright Blue Copper recommendations in this paper is in order. The butterfly is currently neither endangered nor threatened. Hence, artificial habitat modification is presently in no way necessary to insure survival of the butterfly. Nevertheless, the proposals have been made in view of the likelihood that this very rare and localized invertebrate could become threatened in the foreseeable future. Such a population decline would not result from collectors or their activities, but rather from habitat destruction and alteration of the remaining valley floor native vegetation, from the growth of already-existing human communities, and/or from the conversion of the native scrubby vegetation into pasture land. The fact that so many of the approximately 30 known populations are located on private property is a forewarning that attempts to preserve most populations will be both difficult and costly.

Habitat modification suggestions proposed here range from very minor alterations (introduction of preferred adult and larval hostplants to population sites where only the less preferred adult and larval hostplant presently grow) to the less minor manipulation of plant cover and density at a particular site. The objective

in any type of habitat modification is to enhance existing populations, particularly those on federal lands which are not likely to be destroyed in the near future. Major habitat modification for the benefit of the Copper would be necessary only in the event that remaining populations were so few in number that drastic measures to enhance or establish populations would be in order. Any habitat or population management which is not permanent (i.e., there is a gradual return to the original condition) can be nothing other than a temporary measure. The permanent solution to human-induced population declines is, of course, the acquisition of adequate habitat, but this is not likely to occur, particularly if it would benefit only one very rare invertebrate. The larger the habitat reserve, the less likely that habitat management will be necessary.

The proposals outlined in this paper for Bright Blue Copper habitat management may appear premature in view of the not-yet-threatened status of this localized butterfly. Yet, I feel it wise to develop these recommendations since the continuing destruction of populations is probable. Likewise, the proposals and other data form a useful tool for locating and assessing potentially favorable habitats within the range of the butterfly, at which population introductions might be attempted. The ultimate results of such attempts will determine the accuracy and completeness of the habitat characterization. Finally, the characterization and qualification of preferred habitat for a butterfly is one step beyond the present tendency toward generalization and simplification. By closely examining the ties between butterfly and environment, and carrying out experiments to determine how many changes in various components of the habitat affect populations of that organism, we should better be able to explain its rarity.

Acknowledgements

The financial support of the Naturalists' Club of Laguna Hills, California, during the 1975 studies, and of the Eppley Foundation for Research of New York, New York, during the 1976 studies, is gratefully acknowledged; this research could not have otherwise been conducted. A number of southern California lepidopterists provided distributional information or aided in discovering additional populations, including Jim Brock, William Klein, Ron Vanderhoff, Chris Henne, John Emmel, and Chuck Sekerman. Robert Dirig and John F. Cryan made valuable suggestions during the preparation of this paper.

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A Preliminary Scan of Rare and Endangered Nearctic Moths

Sidney A. Hessel*

Abstract

Information about rare and endangered Nearctic moths from the author's experience and from questionnaires answered by 22 contributors to the past two "Season's Summaries" *(News of the Lepidopterists' Society)* is presented as a preliminary, informal report. Information is available only for the larger moths: Saturniidae, Sphingidae, and *Catocala*. Human alterations were blamed for most local disappearances of species over the past 30 years, with clearing, drainage, agriculture, chemicals, artificial lights, and vehicular traffic suggested as causes. *Catocala pretiosa* and *Euproserpinus euterpe* may be extinct. Locally extinct or rare over large areas are *Catocala hippolyta*, *C. nebulosa*, *C. piatrix dionyza*, *Ceratomia undulosa* form *engeli*, *Hyalophora columbia*, *Manduca jasminearum*, *Palada scarletina*, *Sphinx luscitiosa*, and many northeastern saturniids. *Anisota finlaysoni* may become extinct as single large oaks, its foodplant, disappear. *Callosamia promethea* disappears locally for years, but then reappears; this fluctuation may be natural.

Introduction

The literature on the subject of this symposium treats mainly the butterflies. A larger number of people collect and study butterflies than moths, probably because butterflies are more conspicuous and have more esthetic appeal; butterflies are also easier to observe and collect in the field and prepare and store for study. As moths are equally pertinent to the subject, however, it is the purpose of this presentation to discuss them as a group with broad treatment geographically and taxonomically. Some moths have not been altogether overlooked in applicable studies oriented to limited, specialized habitats, in the past.

Methods

To obtain information on rare and endangered Nearctic moths, the cooperation of contributors to the past two "Season's Summaries" (published in *News of the Lepidopterists' Society)* was solicited by a questionnaire. Lepidopterists from the Pacific States to the Atlantic and from Canada to the Gulf of Mexico responded to my inquiry. This impressive geographic representation boils down to 22 collaborators, some of whom, however, confined their specific observations to butterflies or presented only general statements overlooking the precise questions I asked. This report is concerned only with moths, but the butterfly information will be passed on to other workers. The survey was not conceived in the expectation of producing crisp, causal findings of broad application. I hope this short report will encourage further carefully documented observations for relevant species. At least some information assaying present populations, sparse and informal as it may be, is here being made available for future studies.

The great numbers of moth species, even uncommon ones, discourage record-keeping. Few collectors have the opportunity for daily observations, especially of light trap catches. In my own case, the operation of a Robinson trap with a 125-watt mercury vapor lamp throughout the night at the same site from late March through November each year afforded valid annual numerical comparisons for those species I recorded daily: Sphingidae, *Catocala*, *Papaipema*, and recently, Saturniidae. As I expected, the only moth species discussed by respondents to the survey belonged to the Saturniidae, Sphingidae, or *Catocala*, with one exception.

Shortcomings of the survey were the limited numbers of observers and of their observations, which precluded satisfactory geographic and temporal coverage for each species. One collaborator found that a species he had considered rare had been so only because he had sought it late in its flight season. It was pointed out by several people that there has long been an awareness of cyclical population fluctuation varying from two to three to over ten years between peaks, or even in the very appearance of the species. I wonder, however, if the term cyclical, so frequently applied to Lepidoptera populations, is valid. Its implication is of greater regularity and predicability than I believe has been evidenced. This, of course, does not invalidate the historical record of the extremes within which populations have been observed to fluctuate.

Factors Affecting the Decline of Moth Populations

Collaborators generally agreed that human influences have become ever more important during the last 30 years, and that beyond doubt they are the reason for the scarcity of many species and for the disappearance of others, particularly those of very limited habitats. This conclusion, of course, is irrefutable in instances of land clearing, swamp drainage, and probably, at times, grazing -- all of which utterly destroy the former biota. Other suggested influences, predictable yet more difficult to appraise for their impacts, included drought, pesticides, herbicides, chemical air and water pollution, radioactive fallout, highway and street lights, vehicular traffic, and overcollecting.

It is not the purpose of this report to discuss at length the values and liabilities of pesticides and herbicides, although some

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*This was the first objective attempt to gather information on Nearctic moth conservation problems. Since he intended to carry it further, Mr. Hessel did not publish the results of his scan prior to his death (see *Atala* 2(2): 19). This paper was presented as part of the Symposium on Endangered and Extinct Lepidoptera held at the 25th Annual Meeting of the Lepidopterists' Society at San Antonio, Texas, in 1972. We felt that the report was of lasting value, containing much original information, and that it should be published. Charles L. Remington, who organized the San Antonio symposium, kindly made the manuscript available. We hope it will serve as a posthumous reminder of Mr. Hessel's deep concern for the welfare of our native moth fauna, and as a memorial to the initiative and foresight he brought to all of his devotions. At the time of writing, Mr. Hessel was Research Associate in Entomology at the Peabody Museum of Natural History, Yale University, New Haven, Connecticut, USA.

respondents did so. No comments of significance were received which did not echo the literature with which most of us are already saturated, except for one very interesting observation from James Mori. Involved professionally in the issue, he wrote:

> It is not always the agricultural pest populations that have benefitted from the dependence on chemical overkill in agriculture. Let me cite two examples of non-agricultural populations that have experienced population booms because of pesticide applications.
>
> In the Santa Maria area of California, the population of *Hyalophora euryalis* (Boisduval) has been at almost epidemic numbers on ornamental Brazilian Pepper Trees grown as windbreaks for vegetable crops, for at least seven years. This is an extremely high pesticide use area. The chemicals applied to the lettuce, celery, broccoli, strawberries, and beans also end up on the Pepper Trees. The pesticides are perhaps more lethal to the hymenopterous and dipterous parasites than to *euryalis*, and therefore the *euryalis* population may have derived a direct benefit from the application of pesticides.
>
> In the Sacramento County tomato-growing regions, extremely high populations of *Atlides halesus* (Cramer) occur adjacent to the tomato fields that receive many airplane-applied pesticides. This is probably another case of the disruption of the natural parasite-predator populations in the area.

Pollutants, perhaps including radioactive fallout, were deemed to have some bearing on populations, depending on proximity of the population to the source of pollution and the threshold of tolerance to the pollutants involved. In the absence of sophisticated experimental investigation, the impact of pollution cannot be realistically evaluated.

Collecting was generally not considered dangerous to the survival of species, except for possible localized effects.

Possibly significant factors which I have not seen mentioned in the literature are highway and automobile lights, which can cause traffic mortality. If automobile radiators are examined in rural areas, they often produce numbers of dead moths which, when multiplied by a factor of traffic density, suggest considerable carnage. While living on Long Island, New York, during the construction of the Southern State Parkway through large, previously unaltered expanses of the Long Island Pine Barrens, I habitually collected with great success at the highway lights mounted high on heavy wooden poles. It was necessary to knock most of the specimens from the poles with a long fishing rod carried for that purpose. When this highway was first opened, traffic was very light, especially at night, and one could easily pull off onto the shoulder and collect. I did this for four or five years, during which time I became well aware of the progressive deterioration in the quality of collecting from season to season. By the time the "No Stopping Except For Emergency" signs appeared, I had long since abandoned my visits for lack of productivity. This was before extensive use of pesticides and the development of synthetic hydrocarbons. The highway still traverses impressive but shrinking stretches of the Long Island Pine Barrens.

Although automobile mortality is probably not a major factor influencing populations of rare species, I have even collected an *Erora laeta* (Edwards) run over by a car! I once counted an average of one Monarch Butterfly *(Danaus plexippus* (L.)) per mile lying on the highway, over a 40-mile stretch along the Pacific Coast Highway north of San Simeon, California. How many more had been blown onto the road margins? Perhaps nocturnal auto traffic could be significant in suburbia, where at least limited vacant areas (appearing suitable to support some of the absent larger moths) still exist.

The disappearance of saturniids and some other large moths, especially in the Northeast, was widely noted by my correspondents. There can be no doubt of a general trend in this direction, despite one contributor's success in calling males with a reared female, even though he had been unable to find cocoons the previous winter. No "cyclical" explanation satisfactorily accounts for the catastrophic depletion of saturniids to the point of no captures of some species over the past dozen years in places which still appear to provide vast amounts of suitable habitats. Due to the abandonment of farming and the resultant encroachment of hardwoods into the fields, there is more "edge land" (normally favorable to many lepidopterans) in Litchfield County, Connecticut, than existed there at the time of the American Revolution. Nonetheless, there as elsewhere, certain conspicuous moths have declined remarkably.

Moth Species Which Have Declined in Abundance

Two North American moths appear to be extinct, or nearly so, at this time -- *Euproserpinus euterpe* H. Edwards (Sphingidae) and *Catocala pretiosa* Lintner (Noctuidae). Concerning the former, Hodges (1971) wrote: "*Euterpe* is one of the very rare species of sphingids that may no longer occur in southern California. To date only three specimens are known, and they were collected about 90 years ago." *C. pretiosa* turned up regularly in collections made prior to about 1912, but not since.** Furthermore, I am aware of no recent reports of northeastern populations of *Sphinx luscitiosa* Clemens or *Catocala nebulosa* W.H. Edwards. *S. luscitiosa* was always considered local in its distribution, but I was able to collect eggs and young larvae in large numbers on willows *(Salix* sp.) and aspens *(Populus* sp.) in the early 1930's in the environs of Roselle Park, New Jersey. *C. nebulosa* seems to have disappeared in the Northeast in the early 1930's.

Neither a species nor a subspecies, but interesting nonetheless in the context of extinction, is the melanic form *engeli* Chermock & Chermock of the sphingid *Ceratomia undulosa* (Walker). Not uncommon in the Pittsburgh, Pennsylvania area during the worst period of soft-coal pollution earlier in this century, it now seems to be totally missing from local samples, the population having assumed the non-melanic, paler grey coloration.

A few more members of the relatively conspicuous moth groups have clearly declined drastically in numbers in recent decades. Seven of these brought sufficient response from my respondents that I can summarize their situations here. I do not consider any of them to be in imminent danger of extinction, except locally:

The eastern sphingid *Manduca jasminearum* (Guerin) was a regular arrival at my moth lights in Connecticut when I started collecting at this locality in 1952, and it remained so through 1955, some nights as many as a dozen individuals coming to the lights. I have taken none since that year. Others who have collected within the northeastern range of *M. jasminearum* have reported similar experiences. One possible reason for the decline of this species is that it was unusually affected by the extremely heavy insecticide use in its territory (chiefly aerial spraying of DDT against Gypsy Moth *(Lymantria dispar* (L.) infestation). A

**There have been several recent captures; see *Atala* 3: 14-15.

possible ray of hope came from one respondent, William Boscoe, who took seven specimens over a short period in 1971, in an area of eastern Pennsylvania which had yielded none during the previous four years. In its wilder haunts in the South, the moth may not have declined in numbers.

Hyalophora columbia (S. I. Smith), the northeastern, Larch-feeding saturniid, truly has become an extreme rarity during this century. Some populations have disappeared altogether through the logging or draining of Larch *(Larix laricina* (DuRoi) K. Koch) communities. Human alteration of the landscape may be firmly designated as the agency of local extinction in most instances of *H. columbia* depletion.

Anisota finlaysoni Riotte, a small citheronine, has only recently been distinguished and named (Riotte, 1969). In a letter the author explained that the moth is only known from around Belleville (Ontario), from a territory between Hamilton and St. Williams, and from a very few old records from Minnesota and Wisconsin. In the field, *A. finlaysoni* prefers single, old, oak trees, especially White Oak *(Quercus alba* L.). As that kind of tree becomes more and more scarce, there is a possibility that the species may be on the way out. However, there is also the possibility that it occurs in many more localities in the Midwest, without having yet been recognized.

Callosamia promethea (Drury) is one of the most challenging species to one interested in fluctuations in abundance. This saturniid is now apparently absent from many areas where it was extremely numerous in the past. However, it has undergone drastic reductions before, followed by great "booms" in abundance. Will it reappear soon in many of the areas where it is now "missing"?

Three noctuids which were once plentiful in localized colonies in southern California have now been eliminated or severely threatened, according to information supplied by Christopher Henne. *Palada scarletina* J. B. Smith has largely withdrawn from the El Segundo dunes since 1966, due to development of the Los Angeles International Airport and surrounding urbanization. *Catocala hippolyta* Strecker was "at one time plentiful in all canyons with Black Cottonwood [*Populus trichocarpa* T. & G.] association, but is now rare, due to human developments." At least into the 1940's, *Catocala piatrix dionyza* H. Edwards occurred in abundance in a colony southwest of Covina in Los Angeles County. Henne interpreted the construction of a new freeway in the vicinity as the cause of its extinction there.

Conclusion

Without individual recognition at this time, I wish to thank all of those who responded to my appeal. In many cases they will receive further correspondence from me requesting elaboration of the information they have furnished. I expect also, under less hurried circumstances, to enlist the help of others not yet approached. This will be directed particularly to the Saturniidae, Sphingidae, and *Catocala*, in which groups interest is widespread. Hopefully, the number of reports and geographical coverage may thereby be sufficient to interpret the data on population changes in these groups with increased confidence.

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The Karner Blue Project: January 1973 to December 1976

Robert Dirig and John F. Cryan

807 East State Street, Ithaca, New York 14850, USA

Abstract

A brief history of the preservation activities of the Karner Blue Project, formed in January 1973 to preserve the Karner Blue Butterfly *(Lycaeides melissa samuelis)*, is presented; results of research on the butterfly are not discussed in this paper. Most past work of the group has been at the famous Karner Pine Bush near Albany, New York, the type locality of the Karner Blue. Misstatements in the recent literature about the Karner Blue are corrected or explained. The objectives of the Karner Blue Project are twofold: to gather and publish data on the butterfly and its pine barrens habitats, and to use this information to help preserve the butterfly and the relict, xeric vegetation with which it is associated, wherever possible.

Introduction: A Brief History of the Karner Blue Project

The "Karner Blue Project," initiated in January 1973, was one of the earliest habitat preservation efforts with which the Xerces Society became involved. Jim Cane wrote to Jo Brewer, asking the Society to assist in saving the Karner Blue Butterfly *(Lycaeides melissa samuelis* Nabokov) (Fig. 1) and its type locality, the Karner Pine Bush, a large inland pine barrens between Albany and Schenectady, New York. Cane's letter, later

Figure 1: Dew-covered female Karner Blue (*Lycaeides melissa samuelis* Nabokov) in nocturnal resting pose on the foodplant, Wild Blue Lupine (*Lupinus perennis* L.), as observed at the Pine Bush on 25 May 1975 by the authors. (Illustration copyright by Don Rittner, 1976; used with permission.)

published (Cane, 1973a), with its request for a popular article on the butterfly for Albany-area newspapers, was referred by Brewer to Robert Dirig. The requested article, summarizing the life history and distribution of the butterfly and mentioning its decline in the Albany area, appeared in March (Dirig, 1973a). In May, at Cane's invitation, both Brewer and Dirig spoke at a symposium on the Karner Blue, Pine Bush, and local preservation efforts, at the New York State Museum in Albany. Each separately visited the Pine Bush at this time, and found larvae of the butterfly which were reared to the imago. In June, a review of this meeting and an account of Brewer's field work appeared (Brewer, 1973), and in July a more detailed account of the meeting was published (Cane, 1973b). Three popular articles on the butterfly and Pine Bush were printed in early autumn (Breen, 1973; Cane, 1973c; Dirig, 1973c).

Throughout the following winter, Dirig corresponded with other lepidopterists and searched the literature to obtain distributional and life history data and information on the status of various populations of the butterfly. In April 1974, at the First Annual Meeting of the Xerces Society at Yale University, New Haven, Connecticut, he presented a detailed report on the Karner Blue situation. A 6-page leaflet on the butterfly and its habitat was published in late spring (Dirig, 1974).

In October 1974, studies of the Buck Moth *(Hemileuca maia* (Drury)) were initiated at the Pine Bush by Dirig and John F. Cryan. This large, beautiful, diurnal saturniid is very local, the Karner population is well known and one of the northernmost extant, and the species had been observed to be declining there for a number of years by Jan K. Krepa, a local lepidopterist. With the beginning of detailed field studies of Pine Bush Buck Moths, the Karner Blue Project broadened from its original emphasis on preserving the butterfly to include the preservation and study of the Buck Moth and all other biota of the Karner pine barrens. A botanical collection was also begun at this time.

In October, while in the field, we met Don Rittner, Albany City Archaeologist and Director of the Pine Bush Historic Preservation Project. In December, he invited us to speak at a meeting in Albany of conservationists interested in Pine Bush preservation. At this time we distributed a booklet on the Karner Blue, Buck Moth, and their Pine Bush habitat (Dirig & Cryan, 1974).

In mid-winter 1975, plans were announced by Albany-area officials to rezone the Pine Bush for development that spring. This caused much publicity in the local press and on radio and television, especially after the Karner Blue and several other butterflies were listed by the Office of Endangered Species for review of status as possibly endangered or threatened (Greenwalt, 1975). An article on Pine Bush Buck Moths appeared in March (Cryan & Dirig, 1975), and a second report on the Karner Blue situation was presented by Dirig at the Second Annual Meeting of the Xerces Society at Cornell University, Ithaca, New York, in April. On 5 May, the Albany Common Council held a public hearing on whether to rezone a large portion of the remaining Pine Bush for development. Five Xerces Society members -- Cane, Cryan, Dirig, Robert M. Pyle, and Frederick C. Schlauch -- testified in opposition to the rezonings; 34 other people representing a wide diversity of organizations also spoke against rezoning at this time (Dirig & Cryan, 1975b). At the hearing we distributed a revised edition of the booklet *Endangered Pine Bush Lepidoptera* (Dirig & Cryan, 1975a). In early summer, the Albany Common Council unanimously rejected the rezonings proposed by the developer.

In the meantime, we spent several weeks at Karner in May and July 1975, studying both broods of Karner Blues. Notes were made and photographs taken of the diurnal and nocturnal resting postures, courtship and mating of the butterfly, and egg placement in the wild. Adult nectar sources were recorded for both broods. The Pine Bush was canvassed to find out exactly where the butterfly occurred and its distribution there was mapped. Observations were made of the annual cycle of the one known larval foodplant of the Karner Blue, Wild Blue Lupine *(Lupinus perennis* L.) (Fig. 1). Herbarium specimens of the foodplant and other flora were collected, and a general Pine Bush insect collection begun. (Much of this information will be published separately.) A very brief resume of the summer's findings was presented by Dirig at the 26th Annual Meeting of the Lepidopterists' Society in Amherst, Massachusetts, in August. Further observations of Pine Bush Buck Moths were made in September and October 1975.

We revisited the Pine Bush in May and June 1976, observed the spring brood of Karner Blues, and collected additional plants. Much information on the Karner population, including the first published photographs of the life stages of the Karner Blue, appeared in a popular, 264-page book on the Pine Bush in June (Rittner, 1976b). The first, small, controlled burning experiment at the Pine Bush was performed on 29-30 April, and was described briefly in Rittner (1976c). To our knowledge, the Karner Blue does not inhabit this control-burned site. We continued field observations of Pine Bush Buck Moths in September and October, with the assistance of Anita and James G. Barbour, Walter A. Koenig, and Gerard Lemmo, and collected additional plants.

In October 1976, the New York State Department of Environmental Conservation ordered a halt to sand mining in the section of Pine Bush approximately 800 feet west of Route 155 and 200 feet north of Old State Road, within the Town of Guilderland. This was the precedential application of the New York State Mined Land Reclamation Act; sand mining was stopped on grounds that it caused irreversible and irreparable damage to the state's natural resources. The huge dune from which sand was being removed is believed to be the "Mount Brizo" mentioned in Bailey (1877). Peter J. R. Buttner, Dirig, Robert L. Miller, Rudolf Petersen, Rittner, and others testified in opposition to the mining at the ensuing hearing, and a decision is pending. Lowell Suring of the Department of Environmental Conservation also announced in December 1976 that the Karner Blue will be the first insect placed on the New York State list of Endangered Species early in 1977. Its listing is independent of our efforts, although evidently based largely on our publications.

Recent Published Errors and Inconsistencies about the Karner Blue

Since the initiation of the Karner Blue Project, a number of errors and inconsistencies have been published about the Karner Blue. We would like to correct or explain the major ones here.

Several misstatements about the present range, distribution, and status of the Karner Blue have been published. *L. m. samuelis* is presently known from about 50 localities in New Hampshire, Massachusetts, New York, Pennsylvania, Ohio, Michigan, Indiana, Illinois, Ontario (Shapiro, 1969); Wisconsin (Masters & Karpuleon, 1975); and Minnesota (Robert P. Dana, 1976, *in litt.).* Populations are apparently extinct in some reported localities, such as on northern Manhattan Island in New York

City (Alexander B. Klots, 1973, *in litt.)* and northern Illinois (Irwin & Downey, 1973). While the butterfly occurs in localized populations, it is usually very common where found. It is likely that additional populations may be discovered as lepidopterists find and explore new sand barrens or pine barrens supporting *L. perennis* in northeastern and north-central North America.

In view of the known range of the butterfly, it is not true that the Karner Blue "is now down to one final foothold, one last colony, located outside of Albany, in the Pine Bush area of Karner," or that its range once extended "from British Columbia to the Catskill Mountains" as was reported by Cane (1973a) and repeated from that source in a later publication (Pyle, 1973); nor is it true that "the Pine Bush represents the Karner Blue's last foothold on this planet" (Rittner, 1976a), or that the butterfly is "endemic" to the Pine Bush (MacRobert, 1975). In addition, the scarcity of the butterfly at the Karner Pine Bush has been exaggerated by Rittner (1976a) and by Dirig (1973a, 1973b, 1973c). Our early maps (Dirig & Cryan, 1974, 1975a, 1975b) show the locations of only a fraction of the colonies at the Pine Bush, although they do accurately represent the locus of the type population. The most recent detailed map (Dirig, 1976) represents the present known locations of the approximately 20 viable Karner Blue colonies at Karner. This local distributional data is based on four weeks of field work in the summer of 1975. (By a "colony" we mean a subpopulation of Karner Blues that restricts most of its activities to a specific area supporting Lupine.) A few more colonies will probably be found, although most of the seemingly suitable habitat at the Pine Bush has been thoroughly explored. We do not mean to imply that most colonies of the type population and several populations of the butterfly elsewhere are not imperilled by imminent development, but the butterfly still seems to occur in abundance where populations persist. However when its habitat and foodplant are destroyed, it will also perish.

Miller (1975) stated: "Quite possibly the Karner locality is one of the poorest places to seek the blue [Karner Blue], at least at this time. . . . The remaining populations of *L. samuelis [sic]* are viable and in no danger." These assertions are false. The Karner Blue population numbers several thousands of individuals at the Pine Bush. Thus this is still one of the best places to see the butterfly. It is the largest of the nine populations we have seen in eastern New York. Several other populations are as gravely endangered by impending development as the Pine Bush population, if not more so, due to their smaller size (in both numbers of individuals and area covered). Another imperilled population is the famous "Hessville," Indiana locality which, like Karner, lies on the outskirts of a sprawling metropolis, Chicago. The butterflies are found there between 11th Avenue and 15th Avenue, the E. J. and E. Railroad tracks, and Colfax Street in Gary, Indiana (Roderick R. Irwin,· 1973, *in litt.*). William D. Winter, Jr. (personal communication) has reported another "fragile" population in Merrimack County, New Hampshire. Eight small populations we have seen in eastern New York could be very easily destroyed by an hour's bulldozing.

Miller (1975) went on to compare the proposed listing of the Karner Blue as "threatened" by the Office of Endangered Species (OES) as "analogous" to the listing of the American Alligator *(Alligator mississippiensis* (Daudin)) as an endangered species "in a decidedly emotional decision." The alligator, he said,

> has bred unmolested for a few years and has enjoyed such a population increase that in some areas it has become a distinct pest. . . . This species is now being proposed for declassification throughout most of its range. . . . This dreary history of the alligator's classification as "endangered" merely demonstrates the fact that such emotional, rather than scientific, assessments of species' status should be avoided if at all possible.

However, we believe that the two situations are not analogous. The Karner Blue has not been listed as either endangered or threatened by the OES, only proposed for review of its status. Even if given the protection prescribed for a federally-designated Threatened or Endangered Species, it is very unlikely that such a local butterfly, which feeds as a larva only upon a native lupine, would increase rapidly to pest proportions. Had the butterfly been ruled endangered or threatened, Miller's remarks about an "emotional decision" might have been justified; the fact that it has not been, pending the gathering of further data, points to the caution with which the OES approaches decisions of this sort.

Brewer (1973) reported that she and Ivy LeMon found ova, ova shells, final instar larvae, and a female adult Karner Blue on and near Wild Blue Lupine along a power line right-of-way at the Karner Pine Bush on 11 May 1973. Subsequent rearing proved that the ova and ova shells were of the Frosted Elfin *(Incisalia irus* (Godart)), a sympatric Lupine-feeder (Jo Brewer, 1973, *in litt.).* The blue butterfly seen on that date was probably either an Eastern Tailed Blue *(Everes comyntas* (Godart)) or a Spring Azure Blue *(Celastrina argiolus* (L.)). Both species occur in large numbers throughout the Pine Bush and should have been on the wing at that time of year. Based on museum specimens, literature records, and our field work, the spring brood of Karner Blue seems consistently to begin flying at the Pine Bush on or a few days after 20 May. Males precede females in emergence by two or three days, so that individuals observed very early in the flight season would almost surely be males. The butterfly seen by Brewer and LeMon on 11 May 1973 was neither collected nor photographed. A very early Karner Blue record is, of course, possible.

Our booklet *Endangered Pine Bush Lepidoptera* (Dirig & Cryan, 1975a) has been incorrectly cited by Orsak [1976] and by Pyle (1976a, 1976b). This is apparently due to the address on the inside back cover. Please refer to our literature cited for the correct citation.

The following will clarify the confusion caused by statements in *Wings* regarding a possible Karner Blue introduction attempt (Brewer, 1974a); this confusion resulted in part from misinformation supplied by us to the *Wings* editor. The Karner Blue is believed to be extinct in the New York City area, and has only been recorded from Brooklyn on Long Island. In 1974, Bob Giffen, Ranger-Naturalist at Hoyt Farm Park, Commack, Long Island, New York, expressed an interest in attempting to introduce the Karner Blue at the Connetquot River State Park on Long Island, a 3600-acre tract of pine barrens quite similar to the Pine Bush. Giffen wrote to Dirig about a livestock source, but never obtained any ova, and no introduction was attempted. We have subsequently decided not to introduce the Karner Blue into any locality where it does not naturally occur for the following reasons. (1) This would be a breach of our ethics concerning the preservation of natural areas. (2) We do not know how the Karner Blue and other organisms in a potential introduction site would interact. (3) Because of this lack of knowledge, there is the distinct possibility of long-term genetic change in introduced Karner Blues or in other organisms affected by the Karner Blue introduction, especially if introduced Karner Blues were later to contact natural Karner Blue populations. (4) There is a good

chance for the preservation of most of the remaining natural Karner Blue populations, due to the development of significant local interest as a result of publicity about the butterfly. There is no reason to introduce Karner Blues into new areas if there is any chance of preserving natural populations. It is our belief that introductions should be employed for maintenance of a species or subspecies threatened with human-caused extinction only as a last resort, and even then, these must be very carefully monitored.

The Karner Blue ova that failed to hatch, mentioned in Brewer (1974b), were obtained by Irwin Leeuw of Cary, Illinois, from a wild-caught female taken in Allegan County, Michigan.

In August 1974, the New York State Department of Environmental Conservation published an article and map describing the preservation of over 350 acres in the Pine Bush (Anon., 1974). Copies of this article and map were sent by us to Jo Brewer and Robert Pyle, and both subsequently published synopses of the article (Brewer, 1974c, 1975; Pyle, 1974, 1976a, 1976b). The original article was in error, however. At the time it was published, the land had not yet been purchased for preservation. The property purchase agreement has still not been consummated, and as of this date no land in the Pine Bush has been officially preserved from development.

Objectives of the Karner Blue Project

The Karner Blue Project has two sets of objectives. One of these deals with the Karner Blue itself, the other with the peculiar kind of habitat to which it is restricted.

We have initiated a survey of all remaining plant communities in the Northeast that may support Karner Blue populations, so that the relict distribution of the butterfly, at least in the eastern part of its range, can be thoroughly mapped. We are interested in gathering and publishing data on these populations, when found, and in preserving them whenever possible. Thus far, efforts have concentrated on the large and endangered type population at the Pine Bush. We have discovered eight previously unknown populations of the butterfly in New York.

All Karner Blue populations we have observed were associated with light, sandy soils supporting a xeric vegetation. In the Northeast, these places usually are (or at one time were) dominated by Pitch Pine *(Pinus rigida* Mill.), and hence are known as "Pine Barrens." Such edaphic habitats, regardless of whether they support Karner Blue populations, contain a wealth of other specialized and often rare plants and animals, such as the Buck Moth. These habitats are rapidly disappearing, and with them will vanish hundreds of species of pine barrens endemics. They deserve much more scientific attention and preservation effort than they have received.

The Karner Blue Butterfly is a symbol of the northeastern Pine Barrens. We have adopted it as a graphic embodiment of our project, which has as its ultimate goal the preservation of as many of these xeric communities as possible.

Discussion and Conclusion

Readers of Xerces Society publications and other recent publications concerning the Karner Blue may have the erroneous impression that the Pine Bush has been preserved and the butterfly thus saved from extinction. Neither is true; the preservation of the Karner Blue is certainly not a "dead issue." On each visit to the Pine Bush we notice further developments. Hopefully, the listing of the butterfly as an endangered species in New York State will aid in habitat preservation efforts, since this will make it illegal to kill or molest the butterfly in any way.

It is our understanding that the United States Office of Endangered Species does not plan to classify the Karner Blue as either "Threatened" or "Endangered" at this time (Paul A. Opler, personal communication), and we concur with that opinion. Because the subspecies ranges widely, it is not threatened with complete extinction. Nevertheless, the claim of Shapiro (1969) that it is the most localized northeastern butterfly may be justified. Presently its stronghold appears to be in Michigan. Although fully realizing the constraints and inconvenience involved in procuring collecting permits, we believe that listing of the Karner Blue as an Endangered Species in New York State is entirely proper, since there are so few (10) extant populations known throughout the state. Nearly all of these are in grave danger of obliteration from human disturbance. In New York, the only population not threatened by development occurs in Genesee County (Shapiro, 1969).

The Karner Blue is a very interesting butterfly from a biological standpoint; it is also very poorly known. Much additional field work is required before we can even begin to understand its natural history and distribution. Whatever assistance readers can provide in the form of sight and collection records, life history observations, photographs, locality information, and specimens would be very much appreciated.

Acknowledgements

Since the origin of the Karner Blue Project, many people have provided information or assisted us in other ways. We would like to acknowledge the help of the following persons: Harry A. Ahles; Glenn J. Applebee; Richard A. Arnold; Anita and James G. Barbour; Jo Brewer; William L. Brown, Jr.; Peter J. R. Buttner; Jim Cane; Robert T. Clausen; Charles V. Covell, Jr.; Robert P. Dana; Kit Dean; Dianne and Rodney Dirig; Harold J. Evans, Jr.; John G. Franclemont; Albert C. and Valeria Frederick; Heidi Hughes; Peter A. Hyypio; Roderick R. Irwin; Fay H. Karpuleon; Alexander B. Klots; Walter A. Koenig; Jan K. Krepa; Roy Latham; Irwin Leeuw; Ivy LeMon; Gerard Lemmo; Jack N. Levy; John M. Louis; Howard H. Lyon; Robert L. Miller; Robert A. Mitchell; Vladimir Nabokov; Mogens C. Nielsen; Larry J. Orsak; L. L. Pechuman; Albert M. Pellegrino; Rudolf Petersen; Doris and Henry Plant; Robert M. Pyle; Don Rittner; Robert Robbins; Steve Roman; Frederick C. Schlauch; Dale F. Schweitzer; Arthur M. Shapiro; David P. Shaw; Ray E. Stanford; Lowell Suring; Eduardo C. Welling; John A. Wilcox; LeRoy Wilcox; William D. Winter, Jr.; and Marjorie W. Woods.

Special gratitude is expressed to Richard A. Arnold, Larry J. Orsak, and David P. Shaw for reviewing all or portions of this paper before publication.

Finally, we gratefully acknowledge the encouraging support of the many people who wrote letters opposing development of the Pine Bush in the spring of 1975.

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Notes

Butterfly Conservation Problems in the Palestinian Region*

In the Palestinian region today, the lepidopterist finds an interesting situation which has developed from an overlay of biogeography and culture. The rich mix of faunal elements, in a land dominated by many centuries of heavy land use, creates a broad and challenging range of nature conservation dilemmas. I wish to relate a number of these problems as I perceived them while residing in Israel, where I conducted extensive field studies of Palestinian butterflies.

Two primary human activities have determined the present floral and faunal composition of the region – cultivation going back at least to the Biblical Period, and centuries of overgrazing by livestock (chiefly goats). About half of the Palestinian butterflies reach the southern limit of their distributions here, and are currently retreating to the north as the region continues to become drier, as it has been since the last glacial advance. Between climatic and human factors, many taxa are heavily stressed. The independence of Israel and its desire to become self-sufficient have placed nature conservation at a very low priority, and many new development projects impact butterfly habitats severely. On the other hand, the current military tension in the area offers inadvertent protection to numerous habitats in contested areas, on the frontier or in places reserved for military purposes.

In the Golan Heights, Israeli occupation in 1967 resulted in intensified agriculture by the native Druze population, as well as other devlopments which have drastically changed the entire area. The southernmost, very small populations of *Lysandra amanda anthaea* Hemming occur there, and I predict their extinction within the Israeli zone in the next few years as occupational pressures exacerbate. An historic ruin known as Tel Dan in Northern Galilee contains the

*This information was provided by Dr. Nakamura to Robert M. Pyle as a contribution to a world Lepidoptera conservation review. Dr. Nakamura has kindly permitted its adaptation for use in *Atala*.

Figure 1: *Iolaus (Epamera) glaucus jordanus* Staudinger on its foodplant *Loranthus acaciae* Zucc. (Loranthaceae). The photograph was taken by the author on 14 July 1971, at Yotvata, ca. 40 kilometers (24.85 miles) north of Elat, Israel.

largest spring in the Lower Middle East, and here lives the southernmost population of *Pararge aegeria aegeria* L. The numbers were low, but the colony seemed relatively secure, inasmuch as the locality is a nature reserve. However, the Nature Reserve Authority has developed the site with facilities for extensive visitation. Heavy recreational use of the spring area threatens the *P. a. aegeria* population, which is widely disjunct from any other. One of the most devastating events for Palestinian wildlife was the drainage of the Huleh Swamp [discussed in depth by Furth in this issue]. Another large and important wetland drained by Jewish immigrants is the Yizrael Valley; here, the local *Tomares nesimachus nesimachus* Obthr. is feared extinct. In Western Galilee, cultivation progressively wipes out the lowland maquis flora which includes two species of *Aristolochia* (pipevine). These support a very few colonies of the papilionid *Allancastria cerisyi speciosa* Stichel. The only secure colony for this striking butterfly seems to be Mount Carmel. South of Mount Carmel in the Menashe region, the rare *T. nesimachus* (referred to above) is linked by its host plant to rich *terra rossa* soils. These soils also happen to be most suitable for agriculture, the advance of which threatens the extirpation of *nesimachus* in this region in the very near future.

The Coastal Plain, the most densely populated part of Israel, retains no butterflies of unusual interest. The Judean Hills, in contrast, harbor considerable diversity in pockets of wild vegetation among the ancient terraces of Biblical villages. Again, however, agricultural innovations on the Israeli side are inimical to this diversity. For example, the Arabs' donkey-pulled, wooden ploughs do not uproot the *Aristolochia* hostplants of *Allancastria deyrollei eisneri* Bernardi; mechanized ploughs do. Afforestation with *Eucalyptus* and conifers introduces another problem here, for it eliminates the undergrowth and its associated insect fauna. Butterflies which have apparently become much rarer and more local in the Judean Hills than previously recorded included *Papilio alexanor maccabaeus* Staudinger, *Aporia crataegi augustior* Graves, *Limenitis reducta schiffermuelleri* Higgins, *Pyrgus melotis melotis* Duponchel, *Muschampia proto heiromax* Hemming, *M. tessellum nomas* Lederer, *Thymelicus actaeon phoenix* Graves, and *T. lineola fornax* Hemming; all of these are near the southern limits of their ranges here.

Ein Geddi, a famed oasis on the western Dead Sea Coast, has recently been badly maligned by recreational use and water flow diversion. Two African species which reach their northern limits with endemic subspecies here are threatened by changes at Ein Geddi: *Colotis phisadia palaesinensis* Staudinger and *Iolaus glaucus jordanus* Staudinger. The specific threat to the latter is destruction of *Acacia, Zizyphus,* and other trees which support the host of the butterfly, a parasitic plant (Fig. 1).

The Arava Valley, part of the Great Rift Valley, has been fairly well protected by the Israeli-Jordanian frontier and the mine fields. The tendency for new settlements to appear in this area gives cause for alarm, however, since it means draining of aquifers essential for the survival of the indigenous flora and fauna. Several resident and seasonally immigrant African butterflies occur only here in the region.

Three lycaenid butterflies are strictly endemic to the Sinai and Palestinian regions. While they are not critically endangered at present, they may each require some degree of protection in the near future. These are *Strymonidia jebelia* Nakamura, *Iolana alfieri* Wiltshire, and *Pseudophilotes sinaicus* Nakamura. All Palearctic in origin, these butterflies probably represent a Pleistocene refuge fauna. Each is very local today, and in each case the threat is to the food-plant directly.

Clearly, the recent surge of human development in Palestine has made an impact on populations of many scarce butterflies. Further field exploration would enhance our knowledge of threatened and endangered insects in the region occupied by Israel and its neighbors. Enough is known already to say that unless specific conservation measures receive strict attention, a number of unusual and attractive butterflies may become extinct in the Palestinian region.

Ichiro Nakamura, 41 Sunrise Blvd., Williamsville, New York 14221, USA.

Grasslands Institute, June 1976

I attended a Grasslands Institute sponsored by the Denver Audubon Society in June 1976, on the Pawnee National Grasslands. The rainy and very windy weather during this visit discouraged insect observation. However, the floristic diversity of the site supported the belief that these prairies would harbor a rich insect fauna. During a previous midsummer excursion to the same area, around Briggsdale, Callippe Fritillaries (*Speyeria callippe* (Boisduval)) and Ridings' Satyrs (*Neominois ridingsii* (Edwards)) both flew prolifically. The present, rewarding state of the shortgrass environment here is particularly pleasing with respect to its history.

The national grasslands were not created to set aside superb examples of prairie communities, but to rescue lands which had been devastated by overgrazing, mismanagement, and drought, culminating in the Dust Bowl. As such, the national grasslands program has been a vast salvage operation. Faunistic surveys corroborate the success of the program. The situation is not, however, ideal. While grazing on the Pawnee National Grassland, the Central Plains Experimental Range, and the private lands in the area is carefully watched to prevent a recurrence of former abuses, conservationists are still wary of certain regional practices. For example, uranium mining accelerates on the Pawnee, and the threat of coal operations looms over the whole of the High Plains of the West. Ornithologists criticize a popular practice known as "pitting," whereby depressions are made in the prairie to aid water retention by the soil. Pitting demonstrably interferes with Mountain Plovers, the best indicator species of intact shortgrass prairie. We do not yet know whether this alteration affects prairie butterflies. Another agricultural activity which could certainly affect grass-feeding insects is the replacement of native grasses with the exotic Crested Wheatgrass (*Agropyron cristatum* (L.) Gaertn.). Of course, plowing the prairie totally disturbs the fauna. Fortunately, the aridity of the Pawnee arbitrates against large-scale plowing, and range managers assured us that pitting and grass replacement would not be carried out over a very large part of the area. Nonetheless all these activities warrant watching with

respect to their impact on rare insect populations.

Colorado lepidopterists do not doubt that notably rare lepidopterans occur on the Pawnee National Grassland, along with more widespread species. In a survey of possible rare and endangered Colorado butterflies prepared recently by Ray E. Stanford, a Director of the Xerces Society, several skippers considered threatened in Colorado were noted as probably occurring on the Pawnee Grassland: *Hesperia ottoe* Edwards, *Atrytone arogos* (Boisduval & Le Conte), *Atrytonopsis hianna* (Scudder), and possibly others. Clearly, the proper management of this area will have major implications for Colorado rarities. A committee of Colorado conservationists has been formed to investigate ways in which conditions as nearly natural as possible can be guaranteed on certain substantial parts of the grasslands. I represent entomological interests on this committee. One idea put forth represents a scenario in which Bison would be introduced to replace cattle as the principal grazers on a portion of a designated reserve.

One other matter of interest which arose from the Grasslands Institute concerns the proposed Narrows Dam. This shallow, water-retentive project would inundate a large amount of rich bottomland currently occupied by agriculture in the Platte River valley south of the Pawnee National Grassland. This might increase pressure to irrigate and plow the shortgrass uplands. A highly unpopular project among conservationists, the Narrows reservoir would drown a lengthy stretch of superb riparian habitat along the South Platte itself – broad benches dominated by Cottonwoods (*Populus* sp.) and willows (*Salix* sp.) and enclosing a wealth of communities in which little entomological work has been done. In fact, this dam might well prevent the rediscovery of *Lethe eurydice* (Johansson) in Colorado, which, according to Stanford, might only be expected in the scarce sedge marshes of the Platte watershed in the northeastern corner of the state. Participants in the Institute floated down the Platte through the endangered section. Especially when compared with the very few visible benefits of the project, the loss of an entire riverine system in this manner would be deplorable.

Robert Michael Pyle, 1 Toll Bar Cottages, Burley-on-the-Hill, Oakham, Rutland, Leicestershire, LE15 7SX, ENGLAND

The Lepidoptera Specialist Group Holds Its Inaugural Meeting

The inaugural meeting of the Lepidoptera Specialist Group (LSG) took place at the United States headquarters of the World Wildlife Fund in Washington, D.C., on 16-19 August 1976. Those participating represented three countries, while apologies and letters of interest arrived from invitees in all parts of the world. Present were John Heath, Norman Moore, and Michael Morris of Great Britain; Gerardo Llamas of Peru; and William Field, Paul Opler, Larry Orsak, and Robert Pyle (Chairman) of the United States. Initial discussion centered on the eventual composition of the Group, which will have members from as many affected countries as possible. The objectives of the LSG emerged as a straightforward mandate to identify critical issues in the conservation of Lepidoptera and other insects, and to develop Action Programmes to deal with these issues. The conferees drafted an embryonic set of priorities in world Lepidoptera conservation management.Unanimously, they agreed upon firm protection of the recently discovered wintering grounds of the Monarch Butterfly (*Danaus plexippus* (L.)) in Mexico as the number one priority in butterfly conservation. Concensus also was reached that habitat conservation should be the primary concern of the Group and the essential element of most Action Programmes, with commercial collecting a very much secondary consideration (only in cases in which actual population reductions can be reasonably suspected). The Group does not believe that trade or private collecting impairs populations in most cases, but that habitat losses endanger a great many entire populations.

It is hoped by the participants in the first meeting that the LSG will serve to clarify what should and can be done to preserve natural populations of the most crucially threatened insects of the world.

A report on the first meeting is in preparation and will soon be available to seriously interested persons. This will discuss additional points considered by the LSG to be of outstanding importance. Suggestions for the attention of the Group will be welcomed and fully considered, especially if accompanied by data. Please send communications or queries about the LSG to the author.

Robert Michael Pyle, Chairman/LSG, 1 Toll Bar Cottages, Burley-on-the-Hill, Oakham, Rutland, Leicestershire, LE15 7SX, ENGLAND

Disappearance of Lepidoptera in Indiana and Ohio

While living in Indiana for the past 15 years, I have failed to find some of the Lepidoptera reported to exist in the state. Perhaps these were plentiful years ago, but they seem to be absent today. Few people take me seriously when I say that most of the specialized feeders will be extinct here before too many more years have passed.

A few years ago I lived in Canton, Ohio. Many of the homes there had Dutchman's Pipe vines (*Aristolochia* sp.) growing around the porches. Pipevine Swallowtail larvae (*Battus philenor* (L.)) were so common that they were the nemesis of many housewives who destroyed the "ugly critters" (they were beautiful to me), and this swallowtail was one of our most common species. A recent visit to Canton suggested that they are all gone – none of the vines are left, hence no *B. philenor*. I am told that the butterfly feeds on Wild Ginger (*Asarum canadense* L.), which grows here, but I have never seen this plant nor the swallowtail itself in the vicinity.

There was also an area where Tuliptrees (*Liriodendron tulipifera* L.) grew, and the Tuliptree Silkmoth (*Callosamia angulifera* (Walker)) was fairly common. The *Liriodendron* went due to housing developments, and with the trees, the moths vanished.

Along the Ohio River near Yorktown, Ohio, in a dense stand of Pawpaw (*Asimina triloba* (L.)), I could find all

stages of the Zebra Swallowtail (*Graphium marcellus* (Cramer)) by the hundreds. That area was taken over by a steel milling operation, and not a single Zebra Swallowtail remains. When I lived in suburban Cleveland after the war I saw an occasional *G. marcellus*, and eventually located a good stand of Pawpaw. The farmer who owned the property told me that the Zebra Swallowtails that were so common had been there for generations. A recent visit to the site made me a little sick -- all a new real estate development, and no more swallowtails, for their foodplant is gone.

When I moved to Indiana in 1960, I surveyed the area. I found *G. marcellus* occasionally, and also the Giant Swallowtail (*Papilio cresphontes* Cramer). I knew that they are specialized feeders, and set out to locate Pawpaw and Prickly Ash (*Xanthoxylum americanum* Mill.), both of which I found. I planted some of these trees on my property, in hopes that both butterflies might colonize the site. Before that could happen, the native stands of Pawpaw and Prickly Ash were destroyed by builders, farmers, and weed-killers. Both swallowtails now appear to be locally extinct.

Perhaps the most common large lepidopteran in the area was the Promethea Moth (*Callosamia promethea* (Drury)). The country roads and railroad rights-of-way were lined with Sassafras (*Sassafras albidum* (Nutt.) Nees.), on which Promethea cocoons could be found by the hundreds in winter. Both the highways and the railroad have been sprayed with herbicides; unpoisoned trees and shrubs have been cut down and destroyed. The few surviving Promethea fall prey, in the larval stage, to birds or other predators, or are parasitized. I have released some adults, only to watch Blue Jays swoop down quickly for a meal.

I predict that in the near future, the only specimens of once-common butterflies and moths will be found in museums and collections. It is a worldwide catastrophe. It has already happened here, and few people appear to care. I really don't know what the Xerces Society can do to save the Lepidoptera. The generation today seems uninterested: Greed has become the way of life. My comments all seem very negative. I am on the board of the Merry-Lea Environmental Center at Wolf Lake, Indiana, which consists of several hundred hectares (acres) that we are trying to preserve for posterity. Of course, butterflies and moths are preserved along with other wildlife and plants.

Ray W. Bracher, 17145 Cherokee Drive, Granger, Indiana 46530, USA

Symposium on Endangered Insects Held at the XVth International Congress of Entomology, Washington, D.C., in August 1976

For the first time, an International Congress of Entomology included a full symposium on conservation in its program. The symposium, titled "Endangered Insects of the World," was organized for the XVth Congress by Paul Opler of the Office of Endangered Species, U.S. Department of the Interior. Several Xerces Society members presented papers for the symposium: Charles V. Covell, Jr., John Heath, Norman Moore, Michael Morris, Larry J. Orsak, Jerry Powell, Jeremy Thomas, and Robert Pyle. (The contributions to this symposium may be published as a single volume.) One symposium speaker felt that the presence of only about one percent of Congress delegates (numbering in the thousands) at the symposium was a symptom of the largest problem in conservation: awareness. Even so, the pioneering event succeeded very well in inserting a responsible conservation theme into the most important world entomological gathering, which for so long has held insect pest eradication as its major emphasis. It was significant that Curtis W. Sabrosky, President of the Congress, mentioned rain forest butterfly conservation in his ecologically balanced presidential address.

Robert Michael Pyle, 1 Toll Bar Cottages, Burley-on-the-Hill, Oakham, Rutland, Leicestershire, LE15 7SX, ENGLAND

A Summary of the Endangered Species Act

The *Endangered Species Technical Bulletin* is a new monthly publication issued by the Office of Endangered Species in Washington, D.C. Some of the information contained in recent issues of this newsletter is abstracted below.

LISTING, DELISTING, AND RECLASSIFYING A SPECIES: All organisms, including butterflies, proposed for placement on the Endangered Species List have to be considered via the following steps before this status is established: (1) A request or petition by individuals or organizations is made to the U.S. Fish and Wildlife Service for action on a species; this must be supported by evidence of endangerment. (2) A review of the evidence is conducted by an ad hoc panel of professional biologists to determine a course of action. Possible actions include further review of species status; immediate publication of a proposed rulemaking in the *Federal Register*; or no further action, if there is insufficient evidence to warrant it. (3) "A Notice of Intent to Review the Status of a Species" may or may not be published by the Fish and Wildlife Service in the *Federal Register*. State governors are given a 90-day period in which to comment on affected species indigenous to their respective states. Individuals' comments also are solicited. (4) The Fish and Wildlife Service makes a decision either to drop the species from consideration or to develop a "Proposed Rulemaking." (The Fish and Wildlife Service acquires its own evidence on the species.) (5) A notice of "Proposed Rulemaking" is published; the public is given 60 days to respond, state governors 90 days. Public hearings on the proposed rulemaking may be requested by anyone during this period. (6) The Fish and Wildlife Service makes a decision utilizing these comments and available evidence. (7) If a decision is made to list an organism as endangered or threatened, a "Final Rulemaking" is drawn up and published in the *Federal Register*. Common and scientific names of the species and its status on the Endangered Species List are given. The range in which the species is either threatened or endangered is indicated, as well as supporting data for the rulemaking and any special regulations applying to the species.

RECOVERY TEAMS: These are groups of biologists (usually Federal and State agency employees) appointed

by the Fish and Wildlife Service to study the biological status of a given threatened or endangered species. A primary goal of each recovery team is to develop a Recovery Plan, a step-by-step list of recommendations outlining efforts needed to improve the status of that species. The ultimate goal is to bring about the removal of that species from endangered or threatened status.

CRITICAL HABITAT: Under the Endangered Species Act of 1973, Section 7, the land, water, and air space needed for the normal survival of a given species are termed its *critical habitat*. Critical habitat has been designated (or proposed) for the California Condor and American Crocodile. Federal agencies are charged with the responsibility of preventing the destruction or adverse modification of any part of this critical area by actions authorized, funded, or carried out by them. The actions of private individuals and State agencies are not affected *unless* funding or approval from a Federal agency is involved.

A free copy of the *Endangered Species Act of 1973* is available from the Office of Endangered Species, U.S. Fish and Wildlife Service, Washington, D.C. 20240, USA. All persons interested in conserving threatened and endangered organisms and preserving their habitats should have a copy of this law.

Larry J. Orsak, Department of Entomology, 201 Wellman Hall, University of California, Berkeley, California 94720, USA

More on Dams and Butterflies

Shortly after the editorial on dams and butterflies appeared in the previous number of *Atala* (3(2) : 37), I was delighted to hear that a Hell's Canyon National River bill had cleared Congress and been signed by President Ford. This great success on the part of conservationists ends the long battle to prevent damming of the deepest canyon in the United States. Incidentally, it will mean the protection of riverine habitat for such rare butterflies as *Papilio oregonius* Edwards and *Parnassius clodius shepardi* Eisner. In the same editorial it was stated that the proposed Benjamin Franklin Dam in Washington State would back up the last wild stretch of the Columbia River "between the McNary Dam pool and the city of Richland." In fact, McNary Dam lies downstream of Richland, while the undammed stretch of the Columbia River is upstream of the city.

Robert Michael Pyle, 1 Toll Bar Cottages, Burley-on-the-Hill, Oakham, Rutland, Leicestershire, LE15 7SX, ENGLAND

Book Review

A New Book on *Catocala*

Legion of Night: The Underwing Moths, **by Theodore D. Sargent, photographs by Harold J. Vermes, drawings by Katherine A. Doktor Sargent; xiii + 222 pp., 8 color plates, many black and white drawings and photographs; 1976. University of Massachusetts Press, Amherst, Massachusetts 01002, USA. $15.00.**

This book is intended to appeal to a diverse audience, including amateur naturalists and lay people, as well as professional biologists. The writing is quite precise, appropriately concise, highly readable, and not in the least stuffy or pretentious. The inclusion of abundant data (much of it as appendices) and literature citations gives this book a great deal more authority than is usual for semipopular writing. The inclusion of a glossary of entomological and biological terms should aid many readers. The bibliography is quite extensive. The book is not a taxonomic work, but it does resurrect some unsolved and generally overlooked taxonomic questions. No new species are described; a few new melanic forms are given *informal* names.

A great deal of emphasis seems to have been placed on aesthetics. This factor, plus the enjoyable writing style, make reading *Legion of Night* a very different experience from that of plodding through a "scholarly journal." Moths have traditionally been associated with death or mystery in various cultures; this idea seems to have consciously been made a part of this book,beginning with the dust jacket. Certainly a more sombre or mysterious design would have been difficult to conceive. The black figure illustrated is a quite recognizable rendering of the ventral wing surfaces of *Catocala miranda* H. Edwards, probably the most sombre American species – and certainly one of the least known.

Chapter I ("Of Men and Names") deals with several prominent nineteenth century entomologists who together named most of the American *Catocala* at least once. It includes quotes from old passages which illustrate their often bitter personal rivalries. Having been largely forgotten in the present century, these make interesting reading.

Chapter II ("A Fertile Theme") is designed to facilitate identification of eastern North American *Catocala* (including forms) and to provide brief summaries of their ranges and foodplant preferences. Color illustrations of 126 specimens representing 71 species are given. The book is by far the most reliable and accurate source of *Catocala* hostplant information that has been published. Only one record seems dubious: that of Wax-Myrtle or Candleberry (*Myrica cerifera* L.) for *Catocala badia* Grote & Robinson, since the plant and moth are nearly allopatric. (This species in fact feeds mostly or entirely on Bayberry (*Myrica pensylvanica* Loisel.).) Some foodplant records were previously unpublished.

The range descriptions are generalized, but more up-to-date than any other published ones. In some cases I wish they had been given in greater detail, especially the southern limits. At least mention of whether specific captures had been made in mountainous areas or elsewhere would have been helpful. The brief descriptions do, however, give a good idea of what the various ranges have been within the past 100 years. Evidence is given that ranges are not constant, and the inclusion of comments on present "status" of the individual species is useful.

One fairly novel and very useful feature is the inclusion of selected *ventral surface* figures. In some species (e.g., *miranda*), underside characteristics are the safest for identification.

Chapter II will be of help to any Xerces Society members who might wish to determine which, if any, local *Catocala* species or important populations are in trouble from human intervention.

Chapters III and IV ("The Lure of Sugar" and "The Lure of Light," respectively) deal with the time-honored moth collecting practices of "sugaring" and attracting with lights. The conclusions reached are based on real data, which are included. Although diurnal collecting is not treated in detail, it is hardly surprising that the Mercury Vapor Robinson Trap was found to be the best sampling device. However, most species came most readily to bait, although the data show this technique to be rather erratic in yield. Sex ratios of moths collected by the various methods are also given. (I might note that light collecting results range from poor to nil in urban/suburban areas, due in large part to the presence of mercury vapor street lights. In such a setting, bait results are sometimes good, however.)

Chapter V ("Of Sports and Sporting ") is perhaps a little harsh on collectors, but should occasionally be read by all who collect moths. Sargent makes it clear that collecting can be a scientifically valuable enterprise if properly done – or it can be little more than an "ego trip." The chapter also deals with the significance and definition of "sports" (or *aberrations*, as many call them). There is a good discussion of interspecific hybrids (and the paucity thereof) in the *Catocala*. Two very likely examples which I have seen are described and illustrated. Some mention of *Catocala badia* var. "phoebe" H. Edwards would have been appropriate here. It is certainly possible that the few "phoebe" specimens from southern Maine and New Hampshire are hybrids between *C. badia* and *C. coelebs* Grote. (Most specimens I have seen come from *C. coelebs* populations.) Var. "phoebe" is briefly mentioned in Chapter II.

Chapter VI ("'Twixt Birth and Death") deals with the basic life histories of *Catocala* in terms readily understandable to a lay person. Rearing techniques are discussed and a number of fine photographs of larvae and mating pairs are included. This chapter begins to explore the biologically most interesting aspect of these moths: their incredible sympatric diversity. The author's fascinating ideas and data are given and the need for more basic knowledge of behavior and other aspects of their life histories is emphasized.

The final two chapters (VII, "Designs for Deceit," and

VIII, "Designs for Display") are truly outstanding; they deal with the functions of the cryptic forewings and contrasting hindwings and various related behaviors. Many hypotheses have been made over the years regarding these, but Sargent seems to have been the first person to test any of them scientifically. His previously published results are summarized and expanded upon. Relevant theoretical discussion is included. The phenomenon of industrial melanism as it applies to *Catocala* is discussed, and the apparent non-universality of the classic explanation (cryptic advantage) is pointed out.

There are a very few minor errors, mostly typographical (e.g., "Barberry" for Bayberry on page 40). There are no errors in identification. The one serious shortcoming of this book is the rather poor reproduction of the color plates. I have seen the original proofs, which were superb. The blame clearly lies with the printer. For identification purposes, though, they should be adequate, with the exception of some figures on Plates 2 and 8. Persons using any of these plates for identification purposes should be aware that the colors are not always quite right.

Fortunately, the superb drawings of Katherine Sargent reproduced very well. All are excellent. The large larva in the drawing which serves as a frontispiece for Chapter VI looks as if it might drop off if touched. The shower of *Catocala* wings preceding Chapter II is captivating, and the Biblical quote well chosen. My favorite is her drawing of a Blue Jay and a *Catocala ultronia* (Hübner) which introduces Chapter VIII, with its accompanying quote from Shakespeare. The drawings are helpful as illustrations, and add immeasurably to the aesthetic appeal of the book.

Some Xerces Society members will doubtless feel that more attention should have been given to conservation in this book (I have, in fact, heard this comment). Perhaps so, but what else could really have been said with any authority? No one knows why *Catocala* numbers fluctuate. Many ranges seem to have contracted recently, while many others have also expanded. Some species are moving into new areas, following the transplanting of their natural or recently acquired hostplants. Few species are known to be restricted to special habitats, most occurring in ordinary wooded areas. We need more research on this aspect of the *Catocala* – soon.

I should state that I have been associated with the author as a graduate student, although I am no longer in residence at the University of Massachusetts. Even so, I believe my review is fair, and I recommend this book enthusiastically to all naturalists, lepidopterists, and evolutionary biologists. It is refreshing to see such an effort directed at the study of Lepidoptera (or, for that matter, any *wild* insects) as something other than objects to be classified or pests to be sprayed.

DALE F. SCHWEITZER, Peabody Museum of Natural History, Yale University, New Haven, Connecticut 06520, USA

Abstracts of Recent Literature

Recent and previously overlooked papers will be briefly summarized in each number. Suggestions, references, and reprints are requested, so that this service can be maximally useful to readers. A photocopy of any paper abstracted in this column is available for personal use at cost (US 3¢ per page), plus postage, from the compiler, Larry J. Orsak (address on inside back cover). Abstracts were written by the compiler and by the Editor-at-Large.

Politics and Issues

Christensen, G. 1975. Wer rottet aus. . . ? Entomol. Z. 85(21): 246-248.

Geiger, H. 1975. Schmetterlingssammler und Naturschutz. Entomol. Z. 85(23): 261-262.

Reimann, O. 1975. Ausrotten oder bewahren helfen? Entomol. Z. 85(24): 273-274.

Christensen defends collectors and insect collecting against the charges that both contribute in great part to the extermination of insects. Geiger replies that in Switzerland, protection of other organisms has largely been a result of ornithological and botanical pressure groups, and urges entomologists to follow this example. Reimann feels that the great majority of collectors collect not for science, but for personal pleasure or profit, and that there is substance in the charges against them.

Fish and Wildlife Service. 1976. FWS protects insects for first time. Fish & Wildlife News, September 1976: 1, 4. The rationale and process for the recent listing of eight butterflies as threatened or endangered by the United States Office of Endangered Species are presented by the agency responsible. Awareness of the need for insect conservation is growing. FWS recognizes dune destruction as a major threat to certain lepidopterans.

Miller, S. E. 1975. Butterfly conservation. Museum Talk (Santa Barbara Mus. Nat. Hist.) 49(1): 19-21. A brief survey article which emphasizes the need for specific habitat reservation and public awareness.

Moriarty, F. 1975. Where have all the butterflies gone?, Chapter 6, pp. 81-97. *In* Pollutants and Animals, a factual perspective, George Allen & Unwin Ltd., London. Contains a popular discussion of the author's research, some of the only hard, experimental work which has been done on butterflies vs. pesticides. Populations have not suffered to the extent popularly believed from insecticides, but certain important sub-lethal effects can be observed, and there is certainly some impact.

Morris, M. G. 1976. Conservation and the collector, pp. 107-116. *In* Heath, J. (ed.), The Moths and Butterflies of Great Britain and Ireland, Vol. I (Micropterigidae — Heliozelidae), Blackwell, Oxford. An appraisal of the need for and organization of British nature conservation as it relates to Lepidoptera. The collecting/anticollecting controversy is resolved by a thorough consideration of the facts. A "moderate and constructive approach to insect conservation" keynotes the chapter, which details what individuals can do for conservation.

Pyle, R. M. 1976. Conservation of Lepidoptera in the United States. Biol. Conserv. 9: 55-75. The development of the butterfly and moth conservation movement in the United States is followed from the earliest instances to the present. Examines the origin and growth of the Xerces Society, and the factors surrounding principal threatened lepidopteran situations. Critical needs in Lepidoptera conservation research and policy are identified, and actions to meet them are suggested.

Pyle, R. M. 1976. The scientific management of butterfly and moth populations; a new thrust of wildlife conservation. Discovery (Yale Peabody Mus. Nat. Hist.) 11: 68-75. Lepidoptera have resource values, among them ecological indicator capacity, research subjects, and esthetic appeal. People in the United States are only now beginning to realize that many lepidoteran populations are declining, and a butterfly conservation movement has grown and coalesced with the formation of the Xerces Society. Habitat management can be applied to conserve rarities; particular needs lie in the California, Florida, and northeastern areas of the country. Author explains how field research, including collecting, aids applied conservation management, and why museum collections are essential to conservation-based studies.

Biogeography and Faunistics

Duffey, E. 1974. Changes in the British Spider Fauna, pp. 293-305. *In* Hawksworth, D. (ed.), The Changing Flora and Fauna of Britain, Syst. Assoc. Spec. Vol. No. 6, Academic Press. Land use changes are thought to be responsible for the extinction or loss of two of the 611 British spiders. Populations of other species have apparently declined, perhaps due to falling water tables in the fens. The apparent rarity of many species appears to be due to insufficient knowledge of their biology. Few of the species appear to be restricted to a single well defined habitat, but these species would benefit by protection and appropriate habitat management.

Gfeller, W. 1975. Geschutzte Insekten in der Schweiz (Protected insects in Switzerland). Mitt. Schweiz. Entomol. Ges. 48: 217-223. Examines the protection of insects under Swiss law from a lawyer's perspective. Only the Large Red Wood Ant (*Formica rufa*) is protected throughout Switzerland, but three cantons have laws protecting some butterflies. Several rare parnassians receive protection in these cantons, but certain common butterflies may likewise not be collected. The laws do not address habitat protection.

Heath, J. 1974. A century of change in the Lepidoptera, pp. 275-292. *In* Hawksworth, D. (ed.), The Changing Flora and Fauna of Britain, Syst. Assoc. Spec. Vol. No. 6, Academic Press. Changes in range and abundance of Lepidoptera in Britain are

reviewed. Habitat and climatic changes are considered responsible for distributional shifts and changes in abundance, habitat alteration being the primary cause of decline. Expansion or decline of range is mapped for 10 species.

Heath, J. 1975. Biological recording in Europe. Endeavor 34: 103-108. A permanent computerized system used in Britain for handling and processing biological data on the European flora and fauna (primarily British) is described and discussed, with emphasis on its use in locating declining organisms.

Nagy, B. 1974. Reliktum Saltatoria fajok a pusztulo Belko hegyen. Folia Entomol. Hung., Rovartani Kozlemenyek (series nova) 27(1): 139-144. The extinction of three orthopteran populations from Belko in the Bukk Mountains, Hungary, is documented, the loss a result of human disturbance. Populations were relicts on the northern limits of species ranges.

Pyle, R. M. 1976. The Eco-Geographic Basis for Lepidoptera Conservation. Unpublished Ph.D. thesis, Yale University. 309 pp. (Available hardbound from University Microfilms, Box 1764, Auburn, Michigan 48106, USA, @ US $15.00.) Butterfly biogeography is employed to define biotic provinces for Washington State. These are compared with existing nature reserve distribution to define future reservation priorities. In a separate section, world Lepidoptera conservation problems and approaches are reviewed.

Schmidt, E. 1974. Faunistisch-okologische Analyse der Odonatenfauna der Nordfriesischen Inseln Amrum, Sylt, und Fohr. Faun. Oekol. Mitt. 4: 401-418. Dragonfly fauna of three German islands are analyzed. Domestic ducks are cited as a cause of population extinction through destruction of pond vegetation.

Ecology, Habitats, and Management

Dempster, J. P., M. L. King, & K. H. Lakhani. 1976. The status of the swallowtail butterfly in Britain. Ecol. Entomol. 1: 71-84. An important analytical study of the autecology of the threatened British Swallowtail (*Papilio machaon britannicus*). Possible reasons for extinction of the butterfly at Wicken Fen are discussed, along with evolved differences between the Wicken and Norfolk Broads populations. The experimental results bear upon efforts to conserve the Swallowtail in Norfolk and reintroduce it at Wicken Fen.

Hardy, A. R., & F. G. Andrews, principal investigators. 1976. A final report to the Office of Endangered Species on contract 14-16-0008-966. 47 pp. The beetle fauna of a series of California sand dunes is surveyed, listed, and discussed; 22 locally endemic species are recommended for protection because of off-road vehicle damage to the fragile dune ecosystems.

Lawton, J. H., U. J. Blumenthal, & A. Fisher. 1974. A survey of the invertebrates of the Pocklington Canal. Naturalist (Yorkshire, England) 928: 19-24. Assesses the probable effects of dredging a Yorkshire canal on a rich, well established aquatic invertebrate fauna. While local extinctions occurred, most species present will probably find refugia within the system and re-disperse as the canal recovers.

Limbert, M. 1975. The gatekeeper butterfly in Yorkshire. Naturalist (Yorkshire, England) 934: 111-114. The status of *Pyronia tithonus* in Yorkshire is examined with reference to human impacts on habitats. Many former colonies have been destroyed, due to agricultural and other changes.

Moore, N. W. 1975. The conservation of Odonata in Great Britain. Odonatologica 5: 37-44. Extensive changes in natural aquatic habitats and introduction of artificial ones have caused the diminution of some species of dragonflies and damselflies and the increase of others. Three species have apparently become extinct in Britain since 1950, one on a Site of Special Scientific Interest, through sewage works pollution. Three others have been seriously reduced. Creation of nature reserves, implementation of new aquatic habitats, reintroduction of extinct fenland odonates, and pollution abatement are being pursued.

Owen, J. & D. F. Owen. 1975. Suburban gardens: England's most important nature reserve? Environ. Conserv. 2: 53-59. Butterflies, hover flies, and ichneumonid wasps were systematically sampled with a Malaise trap and other means in a suburban garden in Leicester. A surprisingly high diversity of each was recorded, when compared with the faunas as known for the British Isles and Monks Wood National Nature Reserve. The authors contend that the value of the million or more acres of British gardens as species reservoirs is both high and neglected.

Pierce, J. 1976. All for a vanishing butterfly. Field, 3 June 1976: 1021-1022. A brief article on the conservation aims and prospects for the Large Blue (*Maculinea arion*) in England.

Previously Overlooked

Anonymous. 1925. The protection of insects. Entomol. News 36: 272-273. Reports that the American Entomological Society has adopted a resolution expressing serious concern and disapproval over the use of beautiful insects for art and jewelry purposes.

Announcements & Notices

Acknowledgements

This issue is the combined effort of many people. Because it is the first *Atala* to be typeset, a great deal of time was required to define editorial policies and decide on a new format. I hope you will feel it was worth the wait.

Richard A. Arnold, Frederick C. Schlauch, and David P. Shaw kindly reviewed several articles and notes and made many very valuable suggestions. Helpful advice or expertise was provided by Jo Brewer, John G. Franclemont, George L. Godfrey, Peter A. Hyypio, L. L. Pechuman, and William D. Winter, Jr. Don Rittner granted permission to reproduce the copyrighted drawing used with the article on the Karner Blue Project; this originally appeared in *Pine Bush -- Albany's Last Frontier.*

John F. Cryan, Larry J. Orsak, and Robert M. Pyle, the other editors, contributed much in helping to establish editorial policies and develop format. Richard A. Arnold and Frederick C. Schlauch also lent much assistance in this regard.

Especial thanks to John F. Cryan for much advice and support and for assisting with the layout.

Robert Dirig, Editor

EDITORIAL STAFF OF *ATALA*

SUGGESTIONS FOR CONTRIBUTORS

Formal scientific articles and notes dealing with any aspect of the ecology and conservation of endangered or threatened terrestrial arthropods are solicited. Articles will generally be longer papers, notes not exceeding 1000 words. Reviews of books dealing with terrestrial arthropod conservation or endangered habitats are also invited. Appropriate philosophical papers will be welcomed for use in the "Commentary" section.

All manuscripts should be typewritten on white, 8½ x 11 inch, good quality bond paper, on one side only, double- or triple-spaced throughout, with margins of at least one inch on all sides. The original typescript and at least one (preferably two) xeroxed or carbon copies should be submitted; authors should also retain a copy of manuscripts and figures for later consultation with the editors.

Please include illustrations if appropriate. Figures should be consecutively numbered in Arabic numerals. Hand-drawn figures should be rendered in black ink on good quality white paper. They may be larger than final reproduced size. Black and white glossy photographs may also be submitted. These and artwork will be returned after publication if accompanied by return postage. Figure captions should be typed, double-spaced, on a separate sheet, and the number of the figure lightly pencilled on the back of each drawing or photograph. A sketch map should be included as a figure with all articles or notes dealing in a major way with a specific region or arthropod habitat.

Cover art changes with each issue, and contributions will be gratefully received. Cover illustrations should generally show insects or other arthropods in *living* poses, and prospective cover artists should consult with the Editor before submitting material.

Tables should be numbered consecutively in Arabic numerals and submitted in photo-ready condition on separate sheets. Please include full scientific names, *with authors*, for both plants and animals mentioned in any manuscript submitted for publication in *Atala*. The metric measurement system should be used, with English system equivalents in parentheses if desired. Full references to literature cited should appear in a separate section at the end of articles or commentary papers, but should be parenthetically incorporated within the text of notes. Please include an *informative abstract* of approximately 150 to 250 words with all articles. Avoid footnotes to text statements if possible; such information can usually be included within the text. Words to be set in *italics* should be underlined. Reprints of articles are available at cost. An author will receive a reprint order form after acceptance of a manuscript. The style of *Atala* generally follows that recommended in the *CBE Style Manual* (1972). Abbreviations of journal titles follow *Bibliographic Guide for Editors and Authors* (1974).

Prospective authors may request a copy of the detailed editorial policy of *Atala* from the Editor.

COVER

The beautiful yellow and purple Imperial Moth *(Eacles imperialis* (Drury)) is one of the rapidly disappearing northeastern United States saturniids. In this midsummer nighttime view, set in a dry oak-pine woods typical of many areas with shallow, infertile soil in the Appalachian Mountains, a newly-emerged female Imperial Moth clings to the trunk of its larval host, Pitch Pine *(Pinus rigida* Mill.). Males quickly sense the pheromone released by the female and follow upwind to its source. Massive habitat alterations have evidently caused the demise of many local populations of this magnificent insect in the heavily urbanized Northeast. (See the article on disappearing moths by Sidney A. Hessel in this issue.)

The drawing was rendered in India ink using an ultrafine-pointed crowquill pen by Robert Dirig, and is reproduced approximately 90 percent natural size.


Dirig

ATALA

Volume 5, Number 1

1977

THE XERCES SOCIETY

An international, non-profit organization dedicated to the conservation of terrestrial arthropods and their habitats. Named for the extinct Xerces Blue Butterfly, *Glaucopsyche xerces* (Boisduval). Founded on 9 December 1971.

MEMBERSHIP INFORMATION

Membership in the Xerces Society is open to all interested persons and institutions upon submission of appropriate dues. Adult memberships and institutional subscriptions are US $5.00 and student memberships are US $2.50, for the 1977 calendar year. All members and institutional subscribers receive the journal *Atala* twice yearly; the less formal newsletter *Wings* three times yearly; *Self-Help Sheets* (informal, popular, how-to articles) irregularly, as they are issued; and Society meeting announcements, membership lists, and other communications. Xerces Society publication and administration costs are covered by dues and contributions, which are tax-deductible. A person or institution interested in receiving Xerces Society publications should submit name, address, and appropriate dues to the Treasurer, *Roger Pasquier, 235 East 73rd Street, New York, New York 10021, USA.*

Changes of address, requests for back issues of all publications, and general correspondence about the Society should be sent to the Secretary, *Joan M. DeWind, Briggs Hill Road, Sherman, Connecticut 06784, USA.* Correspondence about terrestrial arthropod conservation issues, Xerces Society policies, and suggestions for *Self-Help Sheets* should be addressed to the President, *Larry J. Orsak, Department of Entomology, 201 Wellman Hall, University of California, Berkeley, California 94720, USA. Atala* contributions should be mailed to the Editor, *Robert Dirig, 807 East State Street, Ithaca, New York 14850, USA.* Less formal items for inclusion in *Wings* and contributions, questions or comments about the Butterfly Count should be addressed to the *Wings* Editor and Butterfly Count Coordinator, *Mary Hathaway, P.O. Box 123, Durham, New Hampshire 03824, USA.*

Typeset by Towne Typesetting, Deposit, New York, USA.
Printed by Wilcox Press, Inc., Ithaca, New York, USA.
Published at Ithaca, New York, USA, in December 1977.

ATALA

JOURNAL OF THE XERCES SOCIETY

Volume 5 | 1977 | Number 1

Commentary

Presidential Message

Larry J. Orsak

201 Wellman Hall, University of California, Berkeley, California 94720, USA

Introduction

Anyone having the opportunity to play a leadership role in an organization almost certainly wants to leave his or her mark in some way, perhaps by initiating new programs or discarding old ones, by changing the general framework of the organization to make it more efficient, or by increasing the organization's stability. Likewise, few people who have the opportunity to philosophize in print will turn down this chance. This commentary should be ample testimony to the fact that I am no exception to either rule. I thus take this opportunity to introduce myself to the membership. Specifically, I will comment on some aspects of the Xerces Society which I would like to improve, with your approval, in the coming months, so the Society can more efficiently work to reach the goals for which it was founded. We have come a long way in the last five years, and can be proud of our progress, as our past President has recently asserted (Pyle, [1977]), but we still have many steps to climb.

Professional and Non-professional Members

Any organization is what the membership makes it. We are indeed fortunate to have a widely diverse membership — the young and the old, the professional and the non-professional, the biologist and the non-biologist — but all nature lovers, and all interested in the conservation of nature. This diversity is certainly the most obvious proof that arthropod conservation is not such an esoteric concept that only academically-inclined people have the time or interest to pursue it. Of course, even though this membership heterogeneity brings richness and depth to the Xerces Society, it also brings with it certain problems, since diversity of membership means a diversity of opinions. Although we are united by a common goal, the ways by which we are to achieve this goal will never be universally agreed upon. One area of friction within the Society concerns the extent of participation of professional entomologist members (and their impact on the Society's activities and publications) in comparison with the participation and impact of our non-professional members. On one extreme we find individuals who would like the Xerces Society to be a professionally run organization with professional publications (although this is probably more often voiced by non-member entomologists), and on the other those who would like the Society to be a very informal organization with rather "folksy" communications. Neither extreme, however, would be in the best long-term interests of the organization, particularly in view of our diverse membership and in light of the valuable contributions which *both* professionals and non-professionals can make. Obviously, our organization must seek a high level of accuracy in its publications and in its actions, if credibility is to be maintained, and if we are to be recognized and consulted by other conservation organizations, public agencies, other professional and amateur entomologists, and the general public. We will have little success in preserving arthropod habitats if there is any doubt that the organism in question is as threatened as we portray it in our publications or in our testimony. Our professional and knowledgeable amateur members are invaluable in that they can provide us with sound data, enabling the Society to make accurate statements on pressing issues. At the same time, our non-professional members are just as indispensable. We cannot become so esoteric in our thoughts and actions that the general public views our purposes in an incredulous manner, and I feel that our non-professional members can do much to help maintain a proper "down to earth" perspective for the goals we seek to reach. Many of our non-professional members have both time and enthusiasm to devote to the Society which the professional does not, due to other obligations — volunteers are absolutely essential to a society such as ours.

Society Publications

I do not think that any more need be said concerning the tremendous value of both non-professional and professional members to the Xerces Society. Yet this still does not solve one important problem. Can (and should) we try to portray, simultaneously, both a professional image and a non-professional "grass roots" image? We find this a particular dilemma in our publications — and most outsiders judge our Society on the quality and level of its publications. Some professionals will no doubt decry any attempt at informality, and nearly all will rightly not tolerate inaccuracies or unsubstantiated statements in our publications. On the other hand, non-professionals will almost certainly prefer a non-technical, readable publication. Both viewpoints are legitimate, but it is not easy to have the "best of both worlds." Fortunately, we have two periodicals, *Wings* and *Atala*, and a compromise is possible: making one publication formal and the other informal. To a great extent, this has always been

true. Yet, in listening to the evaluation of *Atala* by professional members and non-members, the editors of *Atala* have become convinced that the Society would definitely profit by raising the quality and level of this publication. Our present concept is that *Atala,* like all scientific journals, is to be a repository of any information considered as worthy of permanent record. Thus, all timely news items which used to appear in the "Metamorphoses" and "On The Wing" columns of past *Atala* issues will now be found in *Wings,* which assumes part of the role of past *Atala* issues. Additionally, papers submitted for publication in *Atala* will hereafter be refereed by at least two qualified specialists; we hope this will eliminate most errors and resolve inconsistencies before they reach print. I must emphasize, however, that in our attempt to make *Atala* more "professional," we have been *exceedingly careful* to insure that the writing style remains non-technical or semi-technical, and that the format does not become stuffy. As *Atala* Editor Robert Dirig recently stated (1977, *in litt.*), "a publication can be both scientifically accurate and visually beautiful." I couldn't agree more. The new *Atala* format will almost certainly not meet with every member's approval, but I think a proper balance has been struck, in which our many non-professional members will continue to find *Atala* both valuable and interesting reading. In addition, by upgrading *Atala,* we should also find that libraries and institutions will find the journal more attractive, and hence our institutional subscriptions should increase. This is most important; it facilitates our disseminating arthropod conservation information far beyond the immediate membership.

The Lepidoptera Bias

In analyzing the Xerces Society membership, we would probably find that most members are interested primarily in *Lepidoptera* conservation. This is not unexpected, considering the past close ties with the Lepidopterists' Society, the inherent beauty of many Lepidoptera, and the wealth of knowledge available about butterflies and moths when compared with the less well known insect groups. However, in the future we should definitely seek both professional and non-professional members interested and knowledgeable in conservation of groups *other than* butterflies, particularly. When a unique habitat is destroyed, butterflies are not, of course, the only arthropods which succumb. Indeed, the presence of a rare butterfly is often only an indication of general organismal uniqueness or diversity. A more holistic approach, i.e., considering all arthropods in a given habitat, is definitely in order.

The Lepidoptera bias is reflected in our activities as well as in the content of our publications. It is no wonder that many professional non-lepidopterist, non-members who are conservation-oriented entomologists believe that the Xerces Society is an organization for the conservation of Lepidoptera only. We face a quandry not easily resolved: As long as the Society's publications and activities remain primarily Lepidoptera-oriented, we will have difficulty in attracting non-lepidopterists. At the same time it is difficult to focus on other arthropod groups when we lack members interested in beetles, dragonflies, spiders, etc. I leave this topic without presenting a solution, since I know of none. I welcome and solicit your comments and suggestions.

Member Involvement

I feel that the concept of a "grass roots" organization for the Xerces Society is an excellent and efficient way to enhance arthropod conservation awareness and preserve arthropod habitats. Such an organization, of course, requires active member participation in order to be effective. This is not as difficult to achieve in the formative years of a group, when founding members, in a sense, have a personal stake in insuring the organization's success. As an organization matures, it becomes easier to become an uninvolved member, because there is often more concern for the mundane duties of running the society that for the attainment of those goals for which the society was originally founded. The organization senesces and new ideas become less frequent with the declining active participation of members. We simply cannot afford this sort of stagnation. An active membership is a prerequisite to achieving our habitat preservation and conservation awareness goals, and we must be continually conscious of this. Thus, please remember that I will *always* welcome any comments on the Xerces Society's activities, including suggestions for improvement or expansion of our programs. If you are dissatisfied with any aspect of the Society, please let me know; this is how your criticism can be constructive and can actually result in change and improvement within the Society. Without membership feedback, it is most difficult, indeed impossible, to second-guess what the members expect or approve. In short, I would like to see Xerces Society members as more than simply readers of our publications. In this connection, a questionnaire has been prepared as a way to give the Board of Directors a better idea of the composition and interests of the membership, as well as to give you the chance to make suggestions and comments on the Society's activities. The questionnaire is enclosed with this *Atala* mailing, and I urge each of you to complete and return it promptly, since it will serve as an important guide in planning the future emphases and programs of the Society.

Role of The Individual

As stated earlier, the Xerces Society is what you make it. Yet, the Society can never speak for everyone, nor can it always function as efficiently as an individual, particularly when it comes to permeating arthropod conservation awareness among the general public. Thus, an organization has its limits, and I ask you to do what you can as an individual. Publicize the Society and arthropod conservation; we can always use new active members, since this gives the organization additional strength, resources, money, and stability. As long as our membership remains small (it currently stands at about 500), the resulting small financial base makes the initiation of new programs difficult, if not impossible. I do not believe that there are only 500 persons in the world interested in arthropod conservation — there are over ten times that number of professional entomologists in the United States alone! There is no reason why most entomologist/conservationists should not be Xerces Society members. Yet they aren't. We need to find the reasons for this and move to correct them. Much of the problem lies in poor publicity, and you as an individual can do much to alleviate this.

As an individual, you can also give presentations to groups, write articles, or talk to people at an individual level to improve general public awareness for a large percentage of the world's species — arthropods. If this results in an increase in public support for our goals, there can be no doubt that we will be more successful in our efforts. Without public support, progress in preserving arthropod habitats will remain exceedingly difficult.

Personal Goals

All of this brings me to an outline of some of my goals for the coming year. Basically, I hope to enhance the Society's credibility as a voice that is heard when conservation issues relevant to our arthropod conservation pursuits arise. To facilitate this, I will work to increase our membership, the most obvious indication of support for arthropod conservation. I will work to entice more institutional subscribers to our journal *Atala;* this will help us maintain a more visible profile. I hope to continue to improve liaison between the Xerces Society and other conservation organizations. It would be considerably easier to save a habitat because of general organismic uniqueness, rather than because one rare butterfly lives there. By drawing upon the knowledge of botanists, mammologists, ornithologists, and other natural scientists, as conservationists we can better assess the total ecological "value" of a given area and work together to save that site. I also hope to draw frequently upon the store of knowledge possessed by many of our members. I feel that so many members are presently underutilized, and that many definitely have something worthwhile to say. Finally, I hope that we can continue to give modest research grants for several programs in arthropod conservation. If feasible, it would be worthwhile to expand this program, since research gives us the data we need to accurately assess the status of rare organisms. The broadening and stabilizing of our financial base is a prerequisite for this and our other programs, and is a problem not yet solved. Perhaps you have suggestions, or would like to make a contribution.

I can do none of the above without your support and your active help. I greatly look forward to being of service to the Xerces Society in the coming months, and I look forward to your participation in the Society as well.

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Articles

Project Ponceanus and the Status of the Schaus Swallowtail (*Papilio aristodemus ponceanus*) in the Florida Keys

Charles V. Covell, Jr.

Department of Biology, University of Louisville, Louisville, Kentucky 40208, USA

Abstract

The Schaus Swallowtail (*Papilio aristodemus ponceanus*), one of the first two insects listed as "Threatened" by the United States Office of Endangered Species, is apparently endemic only to the upper Florida Keys. The history of its known occurrence and its desirability among collectors is given, along with information regarding its present status. While common in the period 1969-1972, it has been much less so from 1973-1976. Details of "Project Ponceanus," a program to study this butterfly, are given for the years 1972-1976. The importance of the recent discovery of a second yearly brood by C. Hugh Brown is discussed. The prognosis for the survival of *P. a. ponceanus* in southern Florida seems good, especially since much of its habitat is protected as a National Monument.

Introduction

On 26 April 1976, conservation history was made when the Fish and Wildlife Service of the United States Department of the Interior added two swallowtail butterflies to the United States list of Endangered Species in the "Threatened" category. These butterflies, the Bahaman Swallowtail (*Papilio andraemon bonhotei* Sharpe) and the Schaus Swallowtail (*P. aristodemus ponceanus* (Schaus) (Fig. 1), were the first United States insects to receive some measure of nationwide protection. While both can be collected in unrestricted areas as adults, it is now illegal to take immature forms or to sell adult specimens.

At this time, the Bahaman Swallowtail possibly occurs in a very restricted area of the Biscayne National Monument, 13 kilometers (8 miles) at sea off Homestead, Florida. I have never seen one in nature. The report of its presence in Florida is attributed to L.N. Brown (1973); to my knowledge, no one except him and his students has ever seen it there. Since this subspecies is fairly common on the Bahama Islands, and is possibly present only sporadically in the United States fauna, I feel that ruling it "Threatened" was unnecessary and will have no effect on its occurrence in Florida.

The Schaus Swallowtail situation is a bit different. If it is a valid subspecies, then this taxon is found *only* in Florida. Other subspecies are found in the island faunas of Cuba (type locality of nominate *artistodemus*), Hispaniola, and Puerto Rico. The Schaus Swallowtail is Florida's unique population, irreplaceable if lost.

History of the Schaus Swallowtail

William Schaus (1911) described the butterfly at the species level, basing the name on a male and female collected in the Miami area of Dade County, Florida, in May 1898; the types are in the United States National Museum. Barnes & McDunnough (1917) were the first to reduce the status of *ponceanus* to a subspecies of *aristodemus* Esper. While Holland (1931) continued to consider it a valid species, others (such as Bates, 1934) considered it a subspecies. The latter opinion has held sway in the more recent literature. I am not convinced, however, that the last word has been heard on its status (whether valid species, subspecies of *aristodemus,* or unworthy of distinction even as a subspecies). I would like to see biological studies and modern taxonomic techniques applied to this question.

What has made *P. a. ponceanus* more than just another pretty butterfly in the North American fauna is the aura of rarity and desirability that has surrounded it since the appearance of Florence Grimshawe's article about its discovery, life cycle, and apparent extinction in the Florida Keys (Grimshawe, 1940). While the evidence of Henderson (1945a, 1945b, 1946) showed that the butterfly had recovered within two years of the September 1935 hurricane that Grimshawe said eradicated it, the butterfly became known as one of the really big prizes for a collector of United States butterflies. Its rarity and a word of caution about overcollecting it were mentioned by Klots (1951), and again by Kimball (1965). I feel that these authors unwittingly brought the kind of attention to this subspecies that would tend to make it the target of overcollecting and inflated prices from dealers, in spite of the warnings.

I have heard of instances of high prices and overcollecting for sale or exchange; however I cannot verify them and will not relate them here. I have been told that Grimshawe herself had financial motives — her extinction story could not hurt business for the specimens she had reared to sell! Again, this is but conjecture.

By the end of the 1960's, out-of-state collectors were beginning to spead the word that *P. a. ponceanus* could be found on Key Largo, Florida. There were also several Florida lepidopterists who collected, reared, and in some cases sold *P. a. ponceanus* specimens at that time, and have been doing so since. But the Schaus Swallowtail was actually quite common in season, especially from 1969 to 1972. I do not think this activity did any harm to the population. As 1970 approached, the "environmental movement" was at a peak. I believe that it was at this time that the beginnings of an organized butterfly conservation/preservation effort began to take shape, beyond the efforts of a few people, widely separated and speaking essentially

unheard among lepidopterists. George Rawson instigated one of the first efforts to preserve a butterfly population in this country. He attempted to reintroduce the Atala Butterfly (*Eumaeus atala florida* Roeber) into the Everglades National Park, using reared material. Though unsuccessful, his attempt was a landmark in American butterfly conservation (Rawson, 1961).

Project Ponceanus

In the early 1970's, I became somewhat tired of uninformed people decrying environmental catastrophes without knowing the facts. So I was ready for a strong reaction when I received a form letter circulated by a lepidopterist colleague in February 1972, saying that something must be done immediately to save the Schaus Swallowtail from extinction. This person thought that *P. a. ponceanus* was found only on Lower Matecumbe Key (where Grimshawe had taken it long ago), restricted to an area about to be bulldozed. I knew that the swallowtail had been common on Key Largo from 1969 to 1971, so I decided to conduct a survey to determine the present status of this subspecies in Florida. With a travel grant from the Tom Wallace Fund for Conservation of the University of Louisville, Kentucky, I went to Florida in May 1972 and met Dr. Rawson, who accompanied me on a survey expedition to the islands of Biscayne National Monument. We found the butterfly to be common there, and were delighted to find it in a place protected from the sort of environmental destruction that has steadily shrunken *P. a. ponceanus* habitat on northern Key Largo. At this site, the butterfly was also protected from overcollecting (only scientific collecting under a permit is allowed), and from insecticide application (neighboring Key Largo is sprayed regularly for mosquitoes). I firmly believe that the Biscayne National Monument is large enough and has the necessary environmental conditions to maintain a *P. a. ponceanus* population indefinitely *if* weather conditions such as droughts, freezes, and hurricanes do not reduce it below a critical density. Alert, efficient, and sympathetic staff members at Biscayne National Monument are aware of their unusual resident, and have been most cooperative in more recent efforts to study this and the other "Threatened" butterfly, the Bahaman Swallowtail.

The 1972 survey was detailed in Covell & Rawson (1973); and a separate report of its discovery (along with that of *P. a. bonhotei)* was given in L. N. Brown (1973). "Project Ponceanus," as the 1972 survey was named, has continued each year since that time until 1977. The goals of follow-up work have been: (1) to assess the present status of *P. a. ponceanus* in its known range (Key Largo and Biscayne National Monument) each year; and (2) to enlarge the range of the butterfly by collecting larvae or females and releasing living material in appropriate habitat on Lignumvitae Key (farther down the keys, off Lower Matecumbe Key) as a precaution against future climatic catastrophes.

Recent Results

A B

Figure 1: Freshly emerged male *Papilio aristodemus ponceanus* Schaus reared in New York on *Xanthoxylum americanum* Mill. from an egg found wild on *X. fagara* (L.) in Monroe County, Florida. Emerged 30 April 1971. Photographs by F. Rutkowski. A. Dorsal aspect. B. Ventral aspect and pupal shell.

From 1973 to 1976 we have found that *P. a. ponceanus* has been very infrequent during late April and early May on Key Largo and in Biscayne National Monument. The population seems to have been at a low ebb, at least at this time of year (some evidence came to me that it was common in early June 1976). No larvae or females have been introduced to Lignumvitae Key in three years of trying, due to lack of material. The reason for the low numbers seems to have been winter drought conditions since the winter of 1972, with resultant retardation of new growth on the Torchwood trees *(Amyris elemifera* L.), foodplant of the Schaus Swallowtail. Females generally oviposit on the new growth only. Work on Project Ponceanus has totalled only a week in the Keys in each of these recent years, so information has been limited. There is word from Biscayne National Monument this year that the freeze of 1977 has apparently not significantly harmed the overall butterfly community there, and that winter rainfall was adequate. (Rainfall had been a bit heavier in the winter of 1975-1976 than in the previous three years, but the effect on spring butterfly levels in the Keys was not seen to be very great in May 1976.) Recent work relevant to Project Ponceanus was reported in Covell (1976). Perhaps the *P. a. ponceanus* population will increase in 1977.

The most significant recent news regarding the Schaus Swallowtail was reported by C. H. Brown (1976). While some people had hoped that *P. a. ponceanus* was double-brooded, and while there were some records for periods other than the late April to June flight period in Florida (Henderson (1945a) gave one August record, and I took a battered specimen in late March 1961), there was no concrete evidence of a second brood. Brown reported observations and captures of *P. a. ponceanus* on Key Largo on 4 and 5 September 1969, on 26 July 1972, and on 28 July 1975. While he reported no late summer observations in 1970 and 1974, I feel he has substantiated the fact that the Schaus Swallowtail has a flight season in the late summer, at least in some years. The population dynamics of this butterfly deserve careful study; Grimshawe indicated that some pupae are capable of extending diapause a second year before the adult emerges. Life history studies involving adaptation to adverse environmental conditions should prove very interesting. More important, we can now have faith that *P. a. ponceanus* is better protected from catastrophe than we thought. With two generations per year, the butterfly might have a faster recovery time if some adverse influence lowered population levels.

The Future for the Schaus Swallowtail

I believe that the Schaus Swallowtail is at this time sufficiently protected in Florida to insure its survival, unless there is a climatic catastrophe. It would be wise to reintroduce a population farther down the Keys to counter the threat of hurricane inundation of restricted habitats. The Key Largo habitat, once vast, is shrinking at an alarming rate; I see no evidence that anyone is going to preserve any portion of the unique hardwood hammock habitat that is vital to survival of Torchwood, and therefore to *P. a. ponceanus*. It is fortunate that Biscayne National Monument serves as a refuge.

The Schaus Swallowtail can fly between islands, as was observed by L. N. Brown (1973). Thus it has the ability to disperse to pockets of appropriate habitat. It can possibly adapt to other rutaceous plants as a food source. Rutkowski (1971) reared it on Prickly Ash *(Xanthoxylum americanum* Mill.) and observed oviposition in nature on Wild Lime (*X. fagara* (L.)), now considered a secondary natural foodplant. Adult flight habits only partially favor its survival. While it may be collected easily at flowers or along trails where it often flies low and slowly, it also spends much of its time in the thick hardwood hammock, and returns there rapidly when alarmed in exposed areas.

From the limited knowledge of life cycle and habits of the Schaus Swallowtail now available, I feel safe in saying that the outlook is good for its survival in the foreseeable future.

Acknowledgements

I thank Frank Rutkowski of New York City for the photographs of his reared *P. a. ponceanus;* Superintendent James W. Todd and biologist James Tilmant of Biscayne National Monument for their cooperation and support; and Burt L. Monroe, Jr., Chairman, Department of Biology, University of Louisville, for making available the funds for this work through the Tom Wallace Conservation Fund.

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Report on the Distribution and Status of *Quercus lobata* Groves in California Which May Support an Ecotype of *Satyrium californica*

James Bruce Walsh

63 La Rancheria, Carmel Valley, California 93924, USA

Abstract

A survey of Valley Oak groves (*Quercus lobata*) in the Sacramento Valley of California was conducted by the author in June 1976. The target organism of the survey, an ecotype of the California Hairstreak Butterfly (*Satyrium californica*), is closely associated with this oak. Only three populations of the butterfly are known, the largest being in immediate danger of destruction by development. Valley Oaks are rapidly disappearing from the Sacramento Valley via human disturbances. The purpose of the survey was twofold: to locate and examine remaining Valley Oak groves and to gather additional distributional data on the California Hairstreak ecotype. No new populations of this butterfly were discovered, despite an extensive search of the major remaining Valley Oak groves from Red Bluff to Modesto. Most of the groves visited were greatly disturbed, some to the point that their survival is highly doubtful. This, coupled with the lack of discovering any new populations of the butterfly, lead to the conclusion that this ecotype should be considered threatened or endangered.

Introduction

In 1973, Arthur M. Shapiro of the University of California, Davis, discovered a previously unknown form of the California Hairstreak Butterfly *(Satyrium californica* (Edwards): Lycaenidae) (Fig. 1) at a relict grove of Valley Oaks *(Quercus lobata* Nee: Fagaceae) at Sacramento. Subsequent collecting demonstrated the existence of this insect in West Sacramento and at Elkhorn Ferry, but the Sacramento population, adjacent to the American River Parkway, remains the largest known. At these sites, the only possible hostplant for *S. californica* is *Q. lobata*, and the adults can be flushed from these trees. In most of California, this butterfly feeds on Wild Lilac (shrubs of the genus *Ceanothus:* Rhamnaceae). Oak feeding is thus highly unusual, and indicates that the Valley population is one of only a handful of endemics which have survived the agriculturalization and urbanization of the Sacramento Valley. Because oak groves are rapidly disappearing, it is important to determine the present distribution of *S. californica* so that steps may be taken to prevent its extinction. The urgency of the situation is underscored by the fact that the American River locality is presently under review by the Sacramento City Planning Commission for development as an industrial park, and the State of California is also considering building offices on this site.

Methods

Oak groves from Red Bluff in the north to Modesto in the south were visited (Fig. 2). Sites were preselected with the help of Dean Taylor of the Department of Botany, University of California, Davis, and by using the plant distribution maps in Griffen & Critchfield (1972). Three criteria for potential survey sites were considered: (1) fairly undisturbed locations; (2) large groves of at least 10 trees; and (3) fairly dense groves. These criteria were chosen so the available time could by maximized by checking the best potential sites for *S. californica.* Other groves (not preselected, but which fit these requirements) observed en route to selected sites were also inspected. The survey area covered about 90 percent of the known range of *Q. lobata* in the Valley, so it is likely that most major groves were examined.

Typically, a survey of each grove involved efforts to locate *S. californica* by checking possible nectar sources and by beating the oak trees to flush adults. In addition, data on the grove itself were taken, including estimation of the number of trees, condition and age of the grove, available nectar sources, and the outlook for preserving each grove.

Results

Unfortunately, no new *Quercus lobata*-associated *Satyrium californica* populations were located. However, additional information regarding the current status of the oak in the Sacramento Valley was gathered, and from this standpoint the survey was worthwhile.

Although no *S. californica* were found, this does not eliminate the possibility that the hairstreak occurs in the groves visited during the survey. There are several reasons for this. First, 1976 was one of the driest years on record for the Sacramento Valley; because of this, the season was about two weeks early. The Valley ecotype of *S. californica* normally flies from mid-May to mid-June. Due to other obligations, the survey was not started until the beginning of June, by which time it appears that the flight season of the American River hairstreaks was past. Second, the primary adult nectar source, Horehound *(Marrubim vulgare* L.: Lamiaceae), finished flowering before the survey had begun. This had a critical impact on the study, as when not feeding, adult hairstreaks could easily remain concealed near the tops of the tall Valley Oaks. Although possible alternative nectar sources were investigated, these might not have been as attractive to the butterflies as Horehound. Finally, the hairstreak is an extremely local insect and might remain undetected even in the most exhaustive survey if the population density were low enough. However, a consistently (not seasonally) low-density population would be greatly affected by human-caused environmental

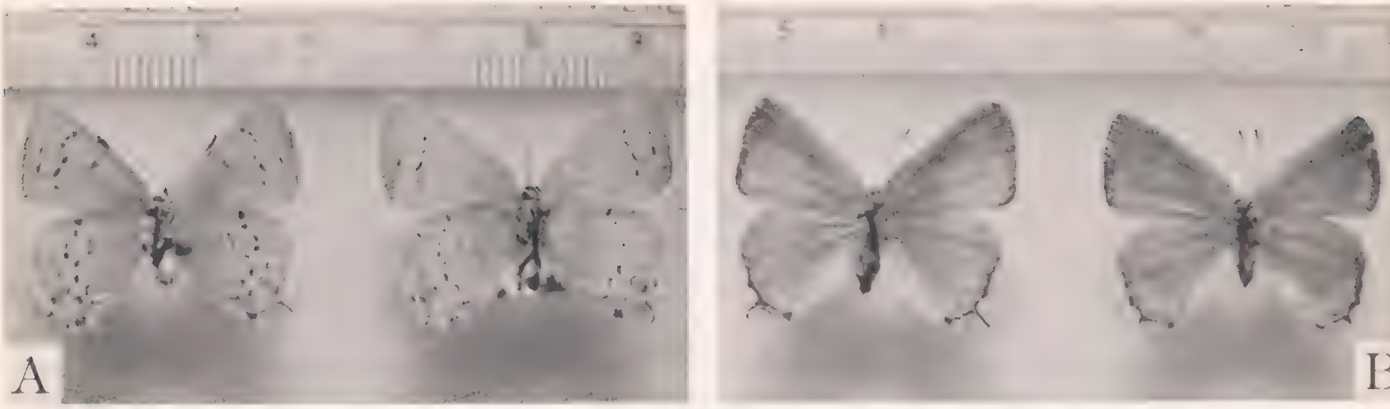

Figure 1: The California Hairstreak (*Satyrium californica* (Edwards)). A. Left: male, ventral surfaces, Sacramento Valley ecotype. Right: male, ventral surfaces, normal phenotype. B. Left: female, dorsal surfaces, Sacramento Valley ecotype. Right: female, dorsal surfaces, normal phenotype. Scale numbers are centimeters.

changes, such as removal of a few trees. Hence, the outlook for continued survival of populations with low numbers of individuals is pessimistic in a human-dominated environment like the Sacramento Valley, where land use control is often minimal, at best.

Status of *Quercus lobata*

Since the Valley ecotype of *S. californica* is believed to utilize only *Q. lobata* as a larval host, knowledge of the exact status of the oak in the Valley is of utmost importance in designing management policies for the butterfly. Based on observations made during the survey, it appears that pure stands of Valley Oak on the alluvial plains of the Valley are clearly endangered. Data for all groves surveyed are in the appendix, and the location of each is mapped (Fig. 2).

The alluvial plains once supported an almost ubiquitous Valley Oak-bunch grass savannah (Shapiro, 1974), but only three "undisturbed" groves (besides the American River locality) could presently be found. One of these groves is being transformed into a park, and another borders highway 99, near prime agricultural and commercial land.

The best remaining grove is Oak Grove Regional Park in San Joaquin County, south of Galt. This grove is being converted into a park by planting grass under many of the trees for picnic and recreational areas. Dean Taylor has informed me that planting grass under oak groves slowly kills the trees, as the grass promotes the growth of a fungus disease. Roughly one-quarter of Oak Grove Regional Park is set aside as a "natural area." To what extent this area will remain undisturbed is unclear at present.

There is a large grove just north of Woodland which appears to be the easiest alluvial plain grove to preserve. It contains about 150 trees, and is the least disturbed grove located during the survey. The grove is located in a purely agricultural area (no commercial land is nearby), and it is small enough (ca. 0.2 hectares (0.5 acres)) that it seems not to be economically feasible to clear it for farming at present, as the cost of removal of the trees would far outweigh additional land brought into production.

A final factor which endangers all of the alluvial plain groves is the narrow hydrologic range that can be tolerated by the Valley Oak. K. S. Thompson of the Department of Geology, University of California, Davis, informs me that Valley Oaks often "drown" in or near a heavily farmed area, due to the unnaturally high water table brought about by excessive irrigation. Due to the amount of irrigated agricultural land around the Woodland grove, this may already be happening. Ironically, Valley Oaks are also dying from lack of water, as the natural annual flooding that once supplied much of the water needed for summer and fall survival no longer occurs. The extensive system of human-built levees, dikes, and dams has stopped this flooding altogether, allowing increased farming and settlement along the alluvial plains — which in turn further dictates the need to control and prevent any flooding. So the local hydrology is a perplexing paradox in which oaks are dying from excess water and are also dying from lack of water, often in nearby locations.

This hydrologic problem is hardest to control, in managing of Valley Oak groves to insure the survival of *S. californica*. Even if the removal of oaks is halted, it would be necessary to regulate nearby irrigation and also to periodically flood groves showing a deficiency of water. The enormous political and bureaucratic problems of regulating water usage are obvious. In light of this, long-term survival of the alluvial plain groves is highly doubtful, even if tree removal is stopped.

Clearly, a situation in which the local hydrology is fairly similar to what it was before European settlement of the Valley would favor the longest survival for Valley Oaks, and hence the hairstreak. Such a situation exists along the banks and levees of the major rivers and their tributary streams in the Sacramento Valley. Here, Valley Oaks are interspaced with riparian vegetation, the latter much more abundant than the former. The northern Sacramento River is especially rich with these mixed riparian/Valley Oak forests or "groves." All river oak groves surveyed were restricted to a very narrow strip along the watercourse, due to human clearing. On the average, no more than a 5 meter (16 foot) strip on either side of the watercourse was left.

This remaining thin strip of riparian vegetation is slowly being cleared. New roads are constantly being built on top of the levees, destroying large amounts of native vegetation. Although I observed that this riparian "strip" was fairly common in the Valley, Valley Oaks and other large trees were rare. This may be because the riparian forests (before European settlement) were widespread but probably unstable along the natural levees, and hence the large trees that were common away from the levees could not grow on or near the levees themselves. When the forests were cleared to the thin strip that now remains, most of the undisturbed area was this unstable land which was most likely

almost totally devoid of large trees. Also, many of the natural levees were cleared and replaced by an extensive system of human-made levees, again destroying much native vegetation.

When Valley Oaks were located, they were usually clustered together, but the density in these groves is rather low: roughly one tree per 23-27 square meters (250-300 square feet) as opposed to the much higher densities on the alluvial plains of about one oak per 2 squre meters (20 square feet) in thick groves. The reason for this is that the alluvial plains groves are a mixture of oaks and other large trees, notably Cottonwood (*Populus fremontii* Wats.: Salicaceae).

A positive aspect of the status of Valley Oaks observed during the survey was the presence of young oaks 1-3 meters (3-10 feet) high. This indicates that Valley Oaks are still successfully reproducing on the Valley floor. Other California oaks, such as the California Live Oak (*Quercus agrifolia* Nee: Fagaceae), are apparently not reproducing in parts of California, as is evidenced by lack of immature trees (Griffin, personal communication).

Outlook for *Satyrium californica* in the Sacramento Valley

As emphasized earlier, the Sacramento Valley ecotype of *Satyrium californica* is thought to be restricted entirely to *Quercus lobata*. Hence the future prospects for the butterfly closely parallel those for the oak.

The solid oak stands on the alluvial plains are endangered, while the mixed oak-riparian forest can be regarded as threatened, based on personal observations made during the survey. If the Valley ecotype of the butterfly is found in most major groves, it could be considered threatened. However, the total lack of new records for the hairstreak from the groves surveyed (albeit during a poor year) suggests that if it does indeed exist there, it is not common. Because of this, it would be prudent to consider the Valley ecotype endangered, at least until an additional survey can be conducted next June, which will hopefully be in a normal rainfall year and hence allow for more conclusive evidence to be obtained on the status of *S. californica*.

Recommendations

The work of MacArthur & Wilson (1967) on island biogeography has shown that if the area of an island declines, the species complement of that island also, in time, declines. A reduction in total island area will result in the extinction of some species which reside there, in order to stabilize the species composition and number on the remaining island area.

Opler (1974), using microlepidoptera associated with various species of oaks, has demonstrated that single tree species can be considered as effective ecological islands. Thus the Valley Oak may be viewed as an ecological island upon which the Valley Oak ecotype of *S. californica* resides. The area of the Valley Oak "island" has drastically declined. Sargent (1961) reported that *Q. lobata* was ". . . most abundant and forming open groves in the central valleys of the state (California)." Today, very few of those open groves are left. Thus, saving the largest possible areas and numbers of Valley Oaks is imperative. Valley Oak groves on the alluvial plains are much larger and of greater density than the riparian oak groves, thus having a larger "island" area. All remaining Valley Oak groves, both mixed riparian and especially the solid alluvial plains stands, should be protected from further oak removal or grove destruction (by activities such as planting grass beneath them), to insure the maximum possible survival of *S. californica*.

Acknowledgements

Sincere thanks to the Xerces Society for providing grant funds which made this survey possible. The continuing encouragement and advice of Robert M. Pyle and Paul A. Opler were instrumental in my initiating work on Lepidoptera conservation. Dean Taylor, Department of Botany, and K. S. Thompson, Department of Geography, University of California, Davis, provided much information on the distribution and biology of *Quercus lobata*. Arthur M. Shapiro provided the framework upon which this survey was based, and read and criticized the manuscript.

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Appendix: Data on Groves Surveyed

Groves were consecutively numbered from number 1 at the north to number 13 at the south end of the Sacramento Valley. The accompanying map (Fig. 2) shows relative locations of the groves.

GROVE NUMBER 1, visited 20 June 1976. **Location:** Cone Grove State Park, off Hwy. 99, east of Red Bluff, Tehama County. **Condition of grove:** ca. 40 oaks, mostly mature, healthy, in riparian grove. Grass extensively planted under most oaks, although a small part of the park is fairly undisturbed. **Possible nectar sources:** Brassicaceae: *Brassica kaber* (DC.) Wheeler, common. **Outlook for finding California Hairsteak:** Poor, especially in modified areas, but may occur in parts of the undisturbed areas.

GROVE NUMBER 2, visited 20 June 1976. **Location:** Antelope Creek, where it crosses state Hwy. 99, southeast of Red Bluff, Tehama County. **Condition of grove:** ca. 25 trees, all mature and very healthy, lining Antelope Creek on both sides of the highway. Grove is fairly undisturbed. **Possible nectar sources:** *B. kaber* common in nearby fields. **Outlook for finding California Hairstreak:** Very good; this grove should definitely be checked in the future.

GROVE NUMBER 3, visited 20 June 1976. **Location:** Woodson Bridge State Recreational Area, east of Corning, Tehama County. Take South Avenue heading west to get to this area. **Condition of grove:** ca. 120 oaks, spread out over three groves. All trees mature and healthy, in riparian groves along the northern Sacramento River. Undisturbed, on state land, so long-range outlook for groves is excellent. **Possible nectar sources:** Asteraceae: *Centaurea* sp., common; *B. kaber* very common. **Outlook for finding California Hairstreak:** Best possible northern location.

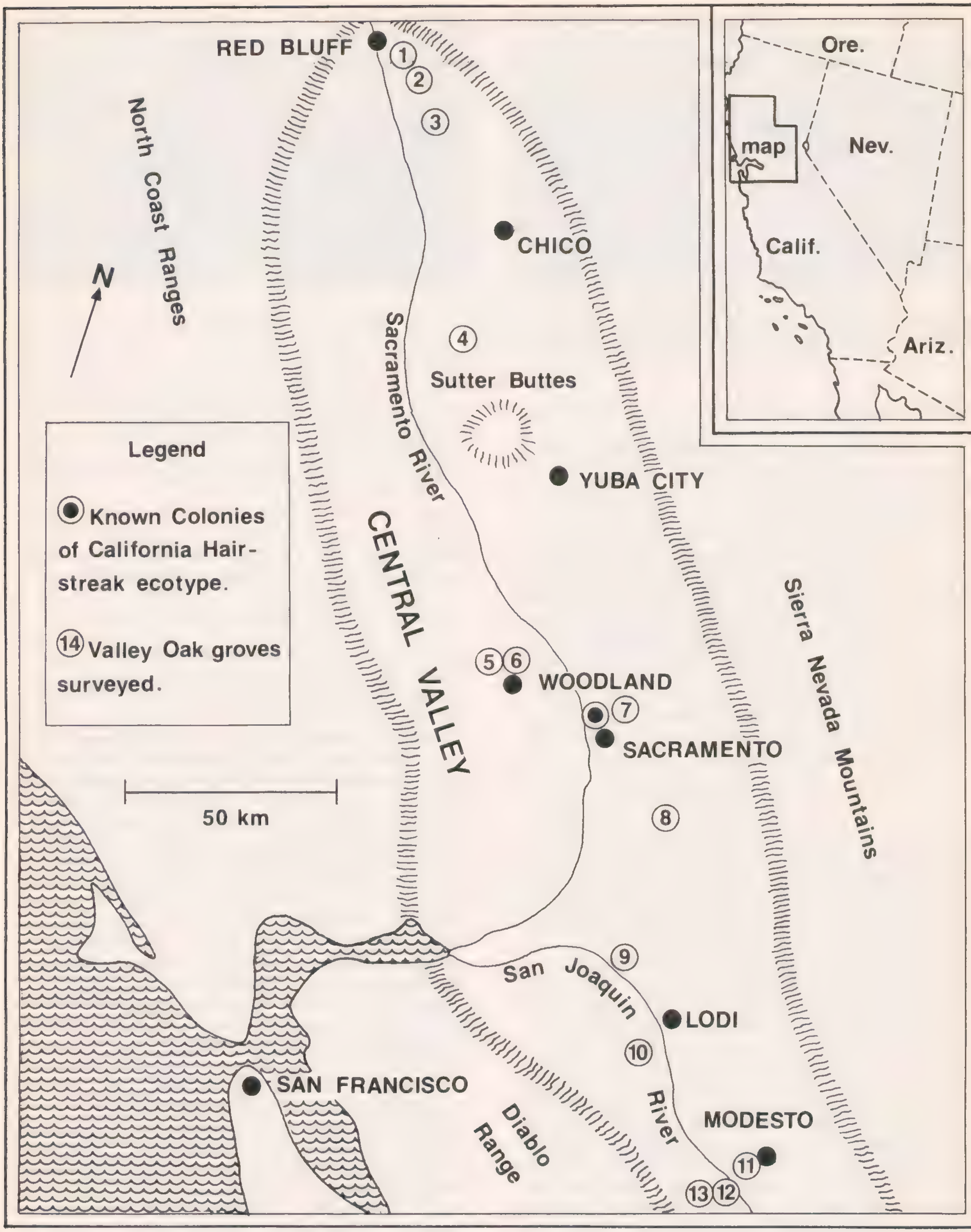

Figure 2: Known distributions of the Valley Oak (*Quercus lobata* Nee) and the California Hairstreak (*Satyrium californica* (Edwards)) in the Sacramento Valley, California. Consult the appendix for details on each grove.

GROVE NUMBER 4, visited 20 June 1976. **Location:** Ord Ferry Road, O.40 kilometer (0.25 mile) east of the Sacramento River, Butte County. Take State Hwy. 162 east, at Willows; at jct. Hwy. 162 and Hwy. 45, take the latter north; at Ord Ferry Road, turn east to grove. **Condition of grove:** ca. 15 trees, mature, some apparently lacking the normal amount of foliage. Grove is in the middle of a wheat field, and the area in the grove is greatly modified. **Possible nectar sources:** *Centaurea* sp., not common; *B. kaber,* common along Ord Ferry Road. **Outlook for finding California Hairstreak:** Poor. A recheck of this location would most likely be a waste of time and effort.

GROVE NUMBER 5, visited 11 June 1976. **Location:** Nelson's Grove, Rd. 188, 0.8 kilometer (0.5 mile) west of jct. Roads 185 and 113, about 2.4 kilometers (1.5 miles) north of Woodland, Yolo County. **Condition of grove:** ca. 70 oaks, solid stand. Grass has been planted beneath most of the trees. Grove is fenced off from the road. **Possible nectar sources:** *B. kaber,* common along the road. **Outlook for finding California Hairstreak:** Poor, grove is disturbed due to planting of grass.

GROVE NUMBER 6, visited 11 June 1976. **Location:** Road 17, 0.8 kilometer (0.5 mile) east of jct. Roads 113 and 17, Yolo County. Roughly 3.2 kilometers (2.0 miles) north of Woodland. **Condition of grove:** ca. 150 mature, healthy oaks, forming a thick, solid stand. Grove site is undisturbed, although irrigated agricultural lands surround it. Overall condition of the grove is excellent. **Possible nectar sources:** *B. kaber,* common along the road; Convolvalaceae: *Calystegia* sp., common in fields on the north and east sides of the grove; *M. vulgare,* common in the grove. **Outlook for finding California Hairstreak:** Outstanding. The grove is solid, mature, and very healthy. *M. vulgare,* the primary nectar source at the American River location, is common in the grove. This is the best prospect for a new *S. californica* population.

GROVE NUMBER 7, visited 5 June 1976. **Location:** Riverside Avenue, north of Melody Lane (vicinity Diener Dodge), Roseville, Placer County. Take first Roseville exit off Interstate 80 North. **Condition of grove:** ca. 35 trees, all mature and healthy. Mostly a solid stand, but a few oaks are scattered along Antelope Creek. Grove is fairly undisturbed, although commercial land surrounds it. **Possible nectar sources:** *Centaurea* sp., common along creek banks; *B. kaber,* common in fields on north side of creek; Caprifoliaceae: *Sambucus mexicana* Presl., a few in field on north side of creek. **Outlook for finding California Hairstreak:** Poor; grove was visited under ideal weather conditions, and *Satyrium sylvinus* (Boisduval) was very common on *Brassica.* All oaks were carefully searched, with no success. In light of this, I seriously doubt that *S. californica* occurs there.

GROVE NUMBER 8, visited 5 June 1976. **Location:** Watt Avenue interchange of Interstate 80, due south of Texaco Service Station on south side of freeway, vic. of Sacramento, Sacramento County. **Condition of grove:** ca. 90 mature Valley Oaks, and 15 trees less than 5 meters (16 feet) tall. A mixed grove of *Q. lobata* and *Q. agrifolia,* following an unnamed creek which runs parallel to a Sacramento bridle path. Grove covers a large area, single oaks lining the creek for roughly 1.6 kilometers (1 mile) from the freeway. **Possible nectar sources:** *Centaurea* sp., very common; *B. kaber* also common. **Outlook for finding California Hairstreak:** Good, although due to the size of the grove and lack of clustered nectar sources, finding *S. californica* here may be difficult.

GROVE NUMBER 9, visited 11 June 1976. **Location:** Consumnes River, where it crosses Hwy. 99, on the east side of the freeway, Sacramento County, about 8 kilometers (5 miles) north of Galt. Get off Hwy. 99 South at Schinger Road, drive south on Schinger Road to the railroad tracks. Park there, follow the tracks to the railroad bridge over the river, go under the bridge, and wade up the river to the groves. **Condition of grove:** ca. 300 oaks in two groves. One is a solid stand of about 175 trees, the other a discontinuous riparian grove of roughly 125 trees, spread out in single file along both sides of the river. Groves are undistrubed, and access to them is difficult, due to problems in crossing private land. Largest complex of Valley Oaks found on the Valley floor. **Possible nectar sources:** *Centaurea* sp., common along the edges of the solid stand grove: *B. kaber,* common in fields on all sides of both groves. **Outlook for finding California Hairstreak:** Excellent. *S. californica* should occur there, but it may be difficult to find, due to grove size and (again) lack of clustered nectar sources.

GROVE NUMBER 10, visited 19 June 1976. **Location:** Oak Grove Regional Park, 4.8 kilometers (3 miles) southwest of Lodi, San Joaquin County. Take Pertier Road exit (heading west) off Hwy. 99 South (jct. about 3.2 kilometers (2 miles) north of Lodi). Follow Pertier Road to its jct. with Thornton Road. Drive south on Thornton Road to Eight Mile Road. Drive west on the latter to the park (on the south side of the road). **Condition of grove:** ca. 250 trees; a large healthy grove of mature trees, covering roughly 1.4 hectares (3.5 acres). Grove is being converted into a park, but is still in its natural state, with markers set up in the grove. Areas of the park are marked as "natural areas." **Possible nectar sources:** *Centaurea* sp., common; Boraginaceae: *Heliotropium curassavicum* var. *oculatum* (Heller) Jtn., fairly rare; *B. kaber,* very common; *M. vulgare,* fairly common under the oaks. **Outlook for finding California Hairstreak:** Uncertain. Probably the largest remaining solid stand of Valley Oaks left in the Valley. Long-term effects of the park on the grove are not known.

GROVE NUMBER 11, visited 19 June 1976. **Location:** Jct. Paradise and Shiloh Roads, vicinity of Tuolumne River, Stanislaus County. Transfer from Hwy. 99 to Paradise Road in Modesto. **Condition of grove:** Small, 11 trees, riparian habitat. Irrigated fields on three sides of the grove, the river on the fourth. All oaks mature and appear healthy. **Possible nectar sources:** *H. curassavicum* var. *oculatum,* uncommon; *B. kaber,* common. **Outlook for finding California Hairstreak:** Poor. Other butterflies very common there; several worn *S. sylvinus* were collected.

GROVE NUMBER 12, visited 19 June 1976. **Location:** Laird Park, 1.6 kilometers (1 mile) east of Grayson, on Shiloh Road, Stanislaus County. **Condition of grove:** 20 mature oaks. Grass has been planted under all the trees. **Possible nectar sources:** *H. curassavicum* var. *oculatum,* rare on levee on south side of grove. **Outlook for finding California Hairstreak:** Very poor. Grove is highly disturbed, and the only nectar sources observed were a few *Heliotropium* growing on a levee some distance away from the grove. **Note:** A solid stand of oaks about 0.2 hectare (0.5 acre) in area was observed across from Laird Park, on the west side of the San Joaquin River. This grove has about 75 trees, and appeared to be undisturbed. I could find no access to it, short of swimming across the river, which was heavily posted "No swimming dangerous currents!"

GROVE NUMBER 13, visited 19 June 1976. **Location:** 0.8 kilometer (0.5 mile) east of Grayson, San Joaquin County, off Shiloh Road, along the east bank of the San Joaquin River. **Condition of grove:** 15 oaks, 8 mature, 7 less than 5 meters (16 feet) in height. Riparian grove, undisturbed location. **Possible nectar sources:** *H. curassavicum* var. *oculatum,* uncommon; *B.*

kaber, common. **Outlook for finding California Hairstreak:** Fair; the butterfly might be found there. This is the southernmost grove which might harbor *S. californica* in the Valley.

Notes

Natural or Human-induced Decline?

Our assessments of changes in invertebrate abundance over time usually consist of impressions rather than hard data, and are usually short-term in nature. This introduces dangerous bias; what we *perceive* as a decline in abundance may not be significant, and true population declines may actually be natural and representative of long-term cycles. A good example of the latter are populations of some underwing moth species (genus *Catocala*), as detailed by Sargent (1976, Legion of Night: The Underwing Moths, Univ. of Massachusetts Press, Amherst, 222 pp.).

Some butterflies in southern California also appear to undergo apparently natural fluctuations. One of these is Wright's Checkerspot (*Chlosyne leanira wrightii* (Edwards)). Emmel & Emmel (1973, The butterflies of southern California, Nat. Hist. Mus. Los Angles Co. Science Series 26: 1-148) stated that the butterfly was quite common early in this century, became quite scarce for 20-30 years, and recently has again been more commonly encountered.

The Cloudless Sulphur (*Phoebis sennae marcellina* (Cramer)) may provide another example. J.A. Comstock (1927, Butterflies of California, privately published, Los Angeles, 334 pp.) characterized this butterfly as a familiar sight in the parks and gardens of southern California. Yet, about 30 years ago, populations declined, and until recently, the butterfly was a truly desirable catch in coastal southern California. Emmel & Emmel (1973, op. cit.) speculated that populations may have declined in response to increasing air pollution levels. Other reasons put forth have included the supposedly less frequent planting of one of the most commonly observed foodplants of the butterfly, *Cassia* spp. (Leguminosae), as an ornamental. Gordon Marsh (*in* Orsak, 1977, The Butterflies of Orange County, California, Univ. of California, Irvine, Center for Pathobiology, [in press]) also mentions another foodplant which he observed as being commonly used in San Diego County, California — Canary Bird Bush (*Crotalaria agatiflora* G. Schweinf.; Leguminosae). He stated that this was once a fairly common ornamental. Due to its rapid growth and its tendency to outcompete adjacent plantings, however, it became less desirable, and hence is now less frequently planted. An occurrence during the autumn of 1976 cast some doubts on all of these theories. For the first time in many years, *P. s. marcellina* suddenly appeared in great numbers throughout southern California; documentation is given in the 1976 "Field Summary" of the Lepidopterists' Society (1977, News Lepid. Soc. No. 2, Mar/Apr: 3-15, 18-21). This great influx of adults may have been derived from resident Arizonan and Mexican populations. In Orange County, California, larvae of the Sulphur appeared on nearly every ornamental *Cassia* bush. The logical question at this point is whether the Cloudless Sulphur will re-establish itself from these migrants, or will it disappear just as quickly as it came? Will this butterfly again become such a frequent sight in urban southern California that we may characterize its abundance with Comstock's words, written fifty years ago? Only time will tell.

In summary, my points are these: First, we must not be too quick to state "decline" for a population. Second, if decline can in fact be documented, we must be convinced that the decline is not a natural one (whether permanent or cyclical) before we blame it on human influences. Comparatively little is known about fluctuations in vertebrate populations, even less about fluctuations in invertebrate abundance.

Larry J. Orsak, 2124 Blake No. 9, Berkeley, California 94704, USA

Announcements & Notices

Lepidoptera Specialist Group

The Lepidoptera Specialist Group (LSG) is a component specialist group of the Survival Service Commission of the IUCN. This important connection was not mentioned in the note on the LSG inaugural meeting in the previous issue (*Atala* 4(1-2): 29). Robert Michael Pyle, Chairman of the LSG, has requested that communications be directed to him at the following address, and *not* at the English address listed with the original note: Robert Michael Pyle, The Nature Conservancy, P. O. Box 1234, N.W. 25th Street, Portland, Oregon 97210, USA.

EDITORIAL STAFF OF *ATALA*

SUGGESTIONS FOR CONTRIBUTORS

Formal scientific articles and notes dealing with any aspect of the ecology and conservation of endangered or threatened terrestrial arthropods are solicited. Articles will generally be longer papers, notes not exceeding 1000 words. Reviews of books dealing with terrestrial arthropod conservation or endangered habitats are also invited. Appropriate philosophical papers will be welcomed for use in the "Commentary" section.

All manuscripts should be typewritten on white, 8½ x 11 inch, good quality bond paper, on one side only, double- or triple-spaced throughout, with margins of at least one inch on all sides. The original typescript and at least one (preferably two) xeroxed or carbon copies should be submitted; authors should also retain a copy of manuscripts and figures for later consultation with the editors.

Please include illustrations if appropriate. Figures should be consecutively numbered in Arabic numerals. Hand-drawn figures should be rendered in black ink on good quality white paper. They may be larger than final reproduced size. Black and white glossy photographs may also be submitted. These and artwork will be returned after publication if accompanied by return postage. Figure captions should be typed, double-spaced, on a separate sheet, and the number of the figure lightly pencilled on the back of each drawing or photograph. A sketch map should be included as a figure with all articles or notes dealing in a major way with a specific region or arthropod habitat.

Cover art changes with each issue, and contributions will be gratefully received. Cover illustrations should generally show insects or other arthropods in *living* poses, and prospective cover artists should consult with the Editor before submitting material.

Tables should be numbered consecutively in Arabic numerals and submitted in photo-ready condition on separate sheets. Please include full scientific names, *with authors*, for both plants and animals mentioned in any manuscript submitted for publication in *Atala*. The metric measurement system should be used, with English system equivalents in parentheses if desired. Full references to literature cited should appear in a separate section at the end of articles or commentary papers, but should be parenthetically incorporated within the text of notes. Please include an *informative abstract* of approximately 150 to 250 words with all articles. Avoid footnotes to text statements if possible; such information can usually be included within the text. Words to be set in *italics* should be underlined. Reprints of articles are available at cost. An author will receive a reprint order form after acceptance of a manuscript. The style of *Atala* generally follows that recommended in the *CBE Style Manual* (1972). Abbreviations of journal titles follow *Bibliographic Guide for Editors and Authors* (1974).

Prospective authors may request a copy of the detailed editorial policy of *Atala* from the Editor.

COVER

This ink drawing by John F. Cryan shows the California Hairstreak (*Satyrium californica* (Edwards)) and its apparent foodplant in the Sacramento Valley of California, the Valley Oak (*Quercus lobata* Nee). The wings expand about 15-17 millimeters (1 inch). See the article **by James Bruce Walsh in this issue.**

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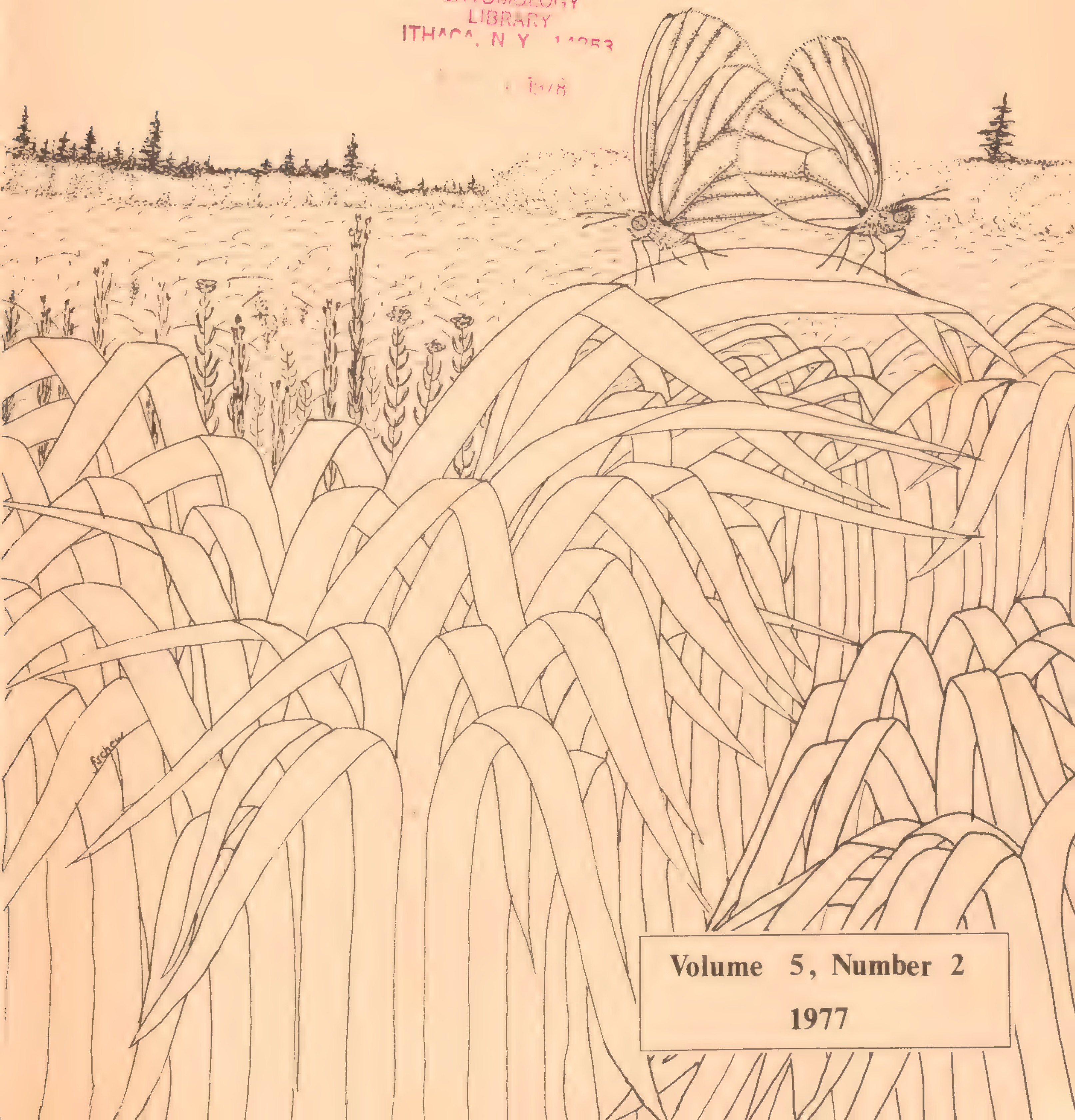

Volume 5, Number 2

1977

THE XERCES SOCIETY

An international, non-profit organization dedicated to the conservation of terrestrial arthropods and their habitats. Named for the extinct Xerces Blue Butterfly, *Glaucopsyche xerces* (Boisduval). Founded on 9 December 1971.

MEMBERSHIP INFORMATION

Membership in the Xerces Society is open to all interested persons and institutions upon submission of appropriate dues. Adult memberships and institutional subscriptions are US $5.00 and student memberships are US $2.50, for the 1978 calendar year. All members and institutional subscribers receive the journal *Atala* twice yearly; the less formal newsletter *Wings* three times yearly; *Self-Help Sheets* (informal, popular, how-to articles) irregularly, as they are issued; and Society meeting announcements, membership lists, and other communications. Xerces Society publication and administration costs are covered by dues and contributions, which are tax-deductible. A person or institution interested in receiving Xerces Society publications should submit name, address, and appropriate dues to the Treasurer, *Roger Pasquier, 235 East 73rd Street, New York, New York 10021, USA.*

Changes of address, requests for back issues of all publications, and general correspondence about the Society should be sent to the Secretary, *Joan M. DeWind, Briggs Hill Road, Sherman, Connecticut 06784, USA.* Correspondence about terrestrial arthropod conservation issues, Xerces Society policies, and suggestions for *Self-Help Sheets* should be addressed to the President, *Larry J. Orsak, Department of Entomology, 201 Wellman Hall, University of California, Berkeley, California 94720, USA. Atala* contributions should be mailed to the Editor, *Robert Dirig, 807 East State Street, Ithaca, New York 14850, USA.* Less formal items for inclusion in *Wings* and contributions, questions or comments about the Butterfly Count should be addressed to the *Wings* Editor and Butterfly Count Coordinator, *Mary Hathaway, P.O. Box 123, Durham, New Hampshire 03824, USA.*

Typeset by The Courier Printing Corporation, Deposit, New York, USA.
Published at Ithaca, New York, USA, in February 1978.
Printed by Wilcox Press, Inc., Ithaca, New York, USA.

ATALA

JOURNAL OF THE XERCES SOCIETY

Volume 5 | 1977 | Number 2

Articles

The Effects of Introduced Mustards (Cruciferae) on Some Native North American Cabbage Butterflies (Lepidoptera: Pieridae)

F. S. Chew

Department of Biology, Tufts University, Medford, Massachusetts 02155, USA

Abstract

Different natural populations of native North American pierid butterflies are negatively affected, positively affected, or not affected by the presence of various introduced mustards that are often taxonomically and chemically related to native foodplants. Rocky Mountain *Pieris napi macdunnoughii* and *P. occidentalis* females oviposit on *Thlaspi arvense*, and New England *P. napi oleracea* and *Anthocaris midea* lay eggs on *Barbarea vulgaris*, but these two alien mustards are lethal to the larvae. Reduction of the proportion of native hostplants to introduced crucifers through habitat alteration, in conjunction with widespread oviposition on the easily accessible, lethal mustards, may deleteriously affect these pierid populations. In contrast, *P. n. oleracea* oviposits and successfully feeds on non-native *Brassica rapa* and *Raphanus raphanistrum*, and California *P. n. microstriata* and *Euchloe* do the same on weedy *Nasturtium* and *Brassica;* these butterfly populations have expanded their host resources by using introduced crucifers. This has a stabilizing effect on the pierid populations. Northeastern *P. virginiensis*, which is monophagous on woodland *Dentaria*, does not oviposit on weedy crucifers because most of these do not occur in its habitat. The variety of butterfly responses to non-native plant species, as evidenced by the mustard-feeding Pieridae, suggests that butterfly habitat assessments should carefully consider the introduced flora.

Introduction

Predicting whether a particular butterfly species can maintain populations in a particular area is still more an art than a science. Despite recent ecological studies of butterflies (Gilbert & Singer, 1975) we have difficulty assessing whether a specific habitat will support a butterfly population. The British encountered difficulties when they introduced close relatives of the extinct Large Copper (*Lycaena dispar* Haworth) into several areas, including Wood Walton Fen, in the early part of this century. These ambitious attempts to establish populations of close relatives of an extinct butterfly are recounted by Ford (1945), and illustrate the discrepancy between our knowledge of what is necessary for butterfly survival and what conditions are sufficient to support self-sustaining populations. In this paper I will describe two cases in which introduced plants may affect the suitability of a habitat for butterflies, especially the caterpillars.

Background

One necessity for butterfly survival and reproduction is the presence of appropriate foodplants for their larvae. While many adult butterflies drink nectar from a large variety of flowering plants, the caterpillars of most species of Lepidoptera are limited to feeding on a small range of plants—a different group of plants for each closely-related group of butterfly species. Behavioral studies show that caterpillars and ovipositing adults recognize their foodplants by the presence of low concentrations of plant chemicals which are secondary or non-nutritive, i.e., not sugars, proteins, fats, or other essential nutrients (Verschaffelt, 1911; Dethier, 1937; Fraenkel, 1959; Feeny, 1976). However, these compounds often have distinctive tastes or smells, such as the essential oils (e.g., pine oil, mint, anise, citrus fragrances) or mustard oil glucosides which give members of the mustard family (Cruciferae) their sharp pungent odor when parts of the plant are crushed. (The mustard oil allyl isothiocyanate is what one smells upon opening a jar of mustard.) Neurophysiological studies show that both caterpillars and adults have sensory cell receptors for specific chemical compounds usually found in the butterfly's foodplants. These receptors are located in the mouthparts of the caterpillar and on the forleg tarsi of the adult female butterfly. An ovipositing female usually taps the plant ("tastes it with her front feet") before laying an egg (Dethier, 1937;

Figure 1: Interdigitation of farm lands and wooded areas near Craftsbury, Orleans County, Vermont. The swamp shown in Fig. 2 lies in the valley at the left. (Photograph by F. S. Chew.)

Figure 2: A White Cedar (*Thuja occidentalis*) swamp near Craftsbury, Vermont. Toothwort (*Dentaria*), the foodplant of *Pieris napi oleracea* Harris, grows under the cedar canopy. (Photograph by J. Douglas.)

Schoonhoven, 1967; Ma & Schoonhoven, 1973).

Thus, most carterpillars and ovipositing females choose larval foodplants by taste rather than by directly assessing nutritional value. This close correspondence between a butterfly species and the secondary chemicals which its foodplants contain is the result of coevolution between butterflies and vascular plants. Ehrlich & Raven (1965) suggest that in the distant evolutionary past (perhaps 75 to 100 million years ago), these secondary chemicals were poisonous to insects and thus protected the plants against insect herbivores. Experimental work shows that caterpillars fed with food which has been adulterated with secondary compounds not normally found in their foodplants can be killed (Erickson & Feeny, 1974). However, over many millions of years, groups of butterflies have evolved physiological adaptations which enable them to tolerate certain chemicals, and also behavior patterns which enable them to recognize plants that contain these chemicals. Indeed, butterflies like the Monarch (*Danaus plexippus* (L.)) are avoided as prey by birds because they are able to store plant chemicals which are poisonous to vertebrates (Brower *et al.*, 1967). Thus the cabbage butterflies of the genus *Pieris* eat only plants which contain mustard oil glucosides; these same compounds are lethal to swallowtail (*Papilio*) caterpillars (Erickson & Feeny, 1974). For many herbivorous insects, plant secondary chemicals presently function as token stimuli by which the larval foodplants are recognized. Only plants containing appropriate token stimuli are recognized as potential larval food, while other plants are merely part of the landscape.

A few Lepidoptera, such as the Southern Army-worm (*Prodenia eridania* Cramer) and the Gypsy Moth (*Lymantria dispar* (L.)), feed on a large variety of plant species. Both the behavior and digestive systems of these insects appear to be different from those of most herbivorous insects (SooHoo & Fraenkel, 1966; Brattsten, *et al*, 1977).

One consequence of choosing food by type of secondary plant chemical is that an insect will often respond to plants which are taxonomically and chemically related to its normal foodplants, but which it has never before encountered (Hefley, 1937; Bowden, 1971; Opler, 1974; Slansky & Feeny, 1977). Thus many crops, introduced from Eurasia, which are cultivated in the United States, are fed upon by native insects when they discover these new food resources. For example, the cultivation of Alfalfa (*Medicago sativa**), introduced from various European sources, provided new food resources for *Colias eurytheme* Bdv. The geographic range of this sulphur has greatly expanded and it has become a pest of this crop. Alfalfa is taxonomically and chemically related to the native North American legumes that must have supported ancestral populations of *Colias* (Berube, 1972).

However, not all introduced plants are cultivated crops. Most are weeds. The flora of eastern North America now includes a large proportion of such weeds; about 20 percent of the species included in *Gray's Manual of Botany* are introduced from Eurasia or western North America (Fernald, 1950; Hulten, 1958). These plants have become established and naturalized in many of the North American roadsides, meadows, and "edge habitats" where butterflies are found. Many provide important nectar sources for adult butterflies, but their potential effects on caterpillars are less obvious. How does this influx of chemically similar (but evolutionarily untested) plants affect butterflies which might recognize them as potential larval food resources?

Figure 3: The weedy mustard *Brassica rapa* in a hayfield near Craftsbury, Vermont. The field was planted with Red Clover and Timothy approximately two months before this picture was taken. The field is 1.6 kilometers from the cedar swamp shown in Fig. 2. (Photograph by F. S. Chew.)

Harmful Effects of Introduced Crucifers on Native Pierids

Representative mustard-feeding members of the family Pieridae ("whites" and "marbles") are found in temperate regions. In North America, they may occur locally [e.g., the Falcate Orange-tip (*Anthocaris midea* Hubn.) or the West Virginia White (*Pieris virginiensis* Edw.)], or they may be among the most ubiquitous species [e.g., the Western Veined White. (*P. napi macdunnoughii* Remington), the Western Checkered White (*P. occidentalis* Reakirt), or the Cabbage White (*P. rapae* (L.)].

Sometimes the response of these butterflies to introduced potential foodplants may be disadvantageous. When newly-hatched caterpillars are quite immobile, as is the case in these species, ovipositing females must choose their egg-laying sites very precisely. Because foodplants are chosen by recognition of token stimuli rather than by assessing the plant for nutrients and possible toxins, female butterflies may oviposit on plants which have the correct token stimuli but which are toxic to caterpillars (Sraatman, 1962; Sevastopulo, 1964). One case which has been studied in some

*Plant nomenclature for northeastern North American species follows Fernald (1950); for Rocky Mountain species, the nomenclature of Harrington (1954) is used.

Figure 4: A sedge-alder swamp with Black Spruce (*Picea mariana*) near Wolcott, Lamoille County, Vermont. *Barbarea orthoceras* and other crucifers grow in dense populations in the foreground. This swamp is surrounded by hayfields, pasture areas, and a mixed coniferous/deciduous woodland in which *Dentaria* is found. (Photograph by J. Douglas.)

detail involves an introduced pennycress, *Thlaspi arvense*. This weed appears to have been introduced in the Rocky Mountain region within the past century, and is frequently chosen by ovipositing females of the native montane butterflies *P.n. macdunnoughii* and *P. occidentalis* (Chew, 1977), although it is lethal to their larvae. It seems extremely maladaptive to place eggs on such an inappropriate plant; the limited mobility of young *Pieris* larvae prevents their reaching another non-lethal crucifer species because individual crucifer species occur in patches of at least a square meter in area (Chew, 1977). Chemical analyses of the crucifers in this montane community suggest that the mustard oil profiles of the pennycress plants closely resemble those of a native mustard on which excellent caterpillar growth rates occur; ovipositing females very probably confuse the lethal introduced plant with the native one (Rodman & Chew, unpublished data). Eventually, the behavior of ovipositing females and the physiological capabilities of the caterpillars should evolve toward consistency with each other: either the ovipositing females will distinguish the lethal plant and ignore it, or caterpillars will be able to complete development on the introduced plant. Probably insufficient time has passed for the situation to be resolved. The annual pennycress invades only disturbed areas, and its occurrence is therefore sporadic (Chew, 1977). Native crucifers which contain toxic compounds apparently pose no problem because the behavior of ovipositing females and the requirements of larvae are consistent with each other. Female pierids ignore the native Western Wallflower (*Erysimum asperum*), which is lethal to larvae (Chew, 1975), and which probably contains the cardiac glycosides found in other members of its genus (Hegnauer, 1964). In the meantime, populations of these native butterflies are extensive (Brown *et al.*, 1957) and native crucifer species are ubiquitous in this montane region (Harrington, 1954; Langenheim, 1962). The number of *Pieris* lost in the mistaken exploitation of this introduced, lethal, weedy crucifer is probably small compared to the number which successfully exploit extensive stands of native crucifer species.

A similar situation may exist for populations of the Falcate Orange-tip (*Anthocaris midea*) in southern Connecticut, and the Mustard White (*P.n. oleracea*) in western Massachusetts. Yellow Rocket (*Barbarea vulgaris*), one of the most pervasive roadside weeds in the eastern United States, overwinters as a well-developed rosette (Root & Tahvanainen, 1969), and is present during early spring when most crucifers are not yet available. Falcate Orange-tip larvae die when fed flowers of *B. vulgaris* (Chew, 1974), and a similar result is obtained when the leaves of this plant are fed to *P.n oleracea* larvae (Chew, unpublished data). In western Massachusetts, *P.n. oleracea* lay eggs on Yellow Rocket, although it is not known to what extent this is a common occurrence. Populations of these butteflies are probably in little danger of placing too many eggs on this lethal plant so long as there are suitable crucifers available during the spring flight season. This condition is met for *A. midea* by dense stands of native rockcresses (*Arabis laevigata* and *A. lyrata*); in western Massachusetts, luxuriant stands of toothwort (*Dentaria*) are available when *P.n. oleracea* flies. The West Virginia White (*P. virginiensis*), which also occurs in western Massachusetts, rarely ventures out of forests, and is unlikely to encounter many weedy

crucifers. Even if members of these populations place some eggs on lethal plants, some larvae will successfully develop on the appropriate foodplants. If the stands of native plants were largely destroyed, however, ovipositing females would be left without alternative, non-lethal hosts, and it would not be surprising if these butterfly populations disappeared.

Even though herbivorous insects are often able to exploit novel plants which are chemically similar to their normal foodplants (such as agricultural crops), not all chemically similar plants are suitable larval food resources. Female pierid butterflies are known to place eggs on many species of Cruciferae (Chew, 1974; Opler, 1974), but these populations cannot successfully exploit all crucifer species as larval food resources. In most cases, the chemical basis for lethality is not fully understood. However, plant defenses against pierid caterpillars may involve both poisonous substances which act after the plant has been ingested (Slansky & Feeny, 1977) as well as substances which make the plant unpalatable and thus deter feeding (Eisner & Halpern, 1971). Despite the size and density of many pierid populations, and the degree of genetic variability that must be present in such large populations, it is doubtful that pierid (or other) butterfly populations could survive the rapid destruction of normal food resources, and successfully switch to these unsuitable plants. The evolution of such adaptation seems to require a number of generations (Chew, 1977). It is thus likely that the rate at which habitats have been destroyed, as well as the destruction itself, have contributed to local extinctions of butterflies and other herbivorous insects.

Favorable Effects of Introduced Crucifers on Native Pierids

The presence of introduced plants may sometimes be advantageous for native pierid butterfly populations. If larvae can develop on these introduced species, then the plants can often augment native food resources, sometimes supporting large numbers of pierids. In northern Vermont, where agricultural lands (hay, corn, pasture) interdigitate with large areas of woodland [Northern White Cedar (*Thuja occidentalis*) swamps, moist mixed deciduous woods], native crucifers growing in swamps and woods are in close proximity to weeds (Figs. 1-4). Where haycrops (Timothy, Red Clover, and Alfalfa) are grown, fields are harrowed and replanted at intervals of several years. During the first year, before the sowed legumes and grasses have become established, weedy mustards predominate. Since not all hayfields are harrowed each year, and crop rotation is practiced, these dense stands of weeds occur in patches. In addition to causing a patchy spatial distribution of mustards, agricultural practices also cause variation in the availability of weedy mustards during the growing season. Mowing during mid- and late-summer removes weedy mustards from hayfields and roadsides. These weeds (e.g., *Brassica rapa, Raphanus raphanistrum*) provide food resources for the native, bivoltine species *Pieris napi oleracea*, which apparently coexists in this area with the multiple-brooded, introduced Cabbage Butterfly (*P. rapae*) (Chew *et al.*, in press). In early summer, *P.n. oleracea* exploits native woodland crucifers (*Dentaria* spp.). When *Dentaria* dies down in mid-summer (Fig. 5), this butterfly then uses introduced crucifers and other available native crucifers such as *Barbarea orthoceras* (Fig. 6). *Dentaria* is too sparse by mid-summer to support large numbers of offspring produced by the second brood of *P.n. oleracea*. The needed additional food resources are apparently provided by the weedy crucifers. Thus the life history of the butterfly and the phenology of several cruciferous species are closely correlated. Bivoltine *P.n. oleracea* could not sustain itself in this locality on *Dentaria* alone. *P. virginiensis*, the native univoltine butterfly reported to feed exclusively on *Dentaria*, flies very early in the spring and its caterpillars complete development and enter diapause before *Dentaria* dies down. Although this species appears to have the genetic mechanism for a second brood (Shapiro, 1971), its reliance on this ephemeral spring foodplant requires univoltinism.

Similar cases have been described. Root & Tahvanainen (1969) documented the succession of plants (many introduced) utilized by mustard-feeding insects during the growing season. In the California Sierra Nevada, native *Pieris napi microstriata* J. A. Comstock utilizes introduced Watercress (*Nasturtium*), which is the only crucifer available during much of the summer (Shapiro, 1975a). In other areas where introduced crucifers have invaded disturbed habitats, sparse populations of as many as six pierid species may coexist on these larval food resources (Shapiro, 1975b). Opler (1969) describes a similar role for introduced *Brassica* species in coastal central California; these plants may permit facultative bivoltinism of *Euchloe* in these areas.

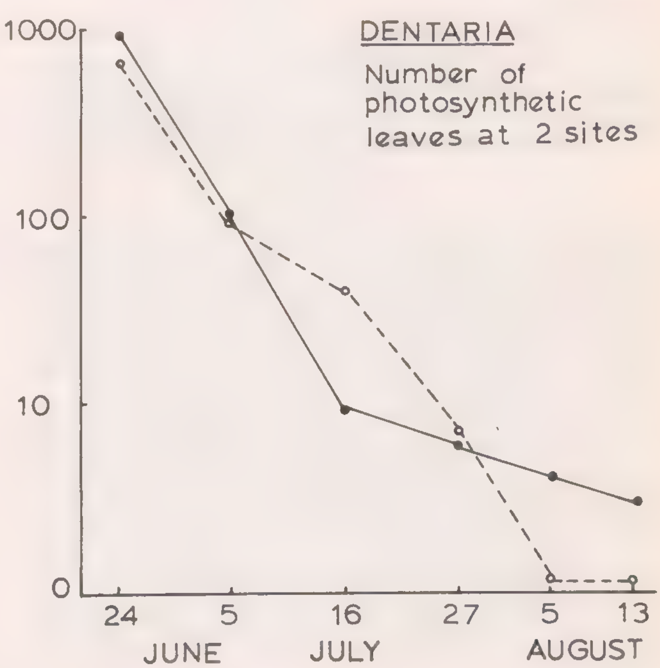

Figure 5: The number of photosynthetic leaves of *Dentaria* available to herbivores at two sites in northern Vermont from late June to early August, 1977. Data (in part) from Chew, Matthews, & Douglas (in press) and from Douglas (unpublished).

Figure 6: Some crucifer species of northern Vermont. A. *Dentaria diphylla*. B. *Barbarea orthoceras*. C. *B. vulgaris*. D. *Rorippa islandica*. E. *Brassica rapa*. *Dentaria* is found in woodlands and wooded swampy areas; *Barbarea orthoceras*, *B. vulgaris*, and *Rorippa* are found in sedge-alder swamps; *Brassica* is the most common mustard in newly-sown hayfields.

In all of these cases, it appears that introduced crucifers provide important, and sometimes critical, food resources for native insects. Their presence may thus stabilize butterfly populations and contribute to their maintenance.

Conclusion

Because a significant proportion of the flora of the eastern portion of North America is naturalized rather than native, these plants must be considered in assessing habitat suitability for butterfly populations. The availability of food to support caterpillar growth and the degree of correlation between plant phenology and insect life history are critical factors. Both appropriate quality and timing of food resources are necessary for butterfly populations to survive, but they are undoubtedly only part of what is required to support self-sustaining populations. The presence of both native and naturalized plants in edge habitats may be one reason why these areas often support a rich butterfly fauna; such habitats may permit butterfly populations to utilize introduced food resources if these are suitable, while providing native alternatives if the introduced plants should prove detrimental.

Acknowledgements

I am grateful to J. R. Douglas, P. A. Matthews, and two reviewers for comments on the manuscript, and to Tufts University, Medford, Massachusetts, for a faculty grant to support research. I also thank the staff of the Center for Northern Studies, Wolcott, Vermont, for their help with research on butterflies in northern Vermont.

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The Butterfly Industry and Butterfly Conservation in Taiwan

Sheldon R. Severinghaus

Department of Natural Resources, Fernow Hall, Cornell University, Ithaca, New York 14853, USA*

Abstract

Untold millions of butterflies and moths are collected each year in Taiwan for commercial purposes, including worldwide export as handicraft items. The butterfly industry employs tens of thousands of people, full- or part-time, in collection and production. Habitat destruction may be more important as a factor threatening butterfly populations than the collecting itself. The government of Taiwan is aware of the value of the island's Lepidoptera but has not yet provided legal protection. Private attempts at habitat restoration (as a means of increasing butterfly populations) have reportedly been made. Prospects for butterfly conservation in Taiwan will depend on the knowledge of the ecology of each species, and on the management measures developed for each.

Introduction

Taiwan (Formosa) has long been known among lepidopterists for the staggering numbers of butterflies collected there for commercial purposes, primarily for worldwide export (Pyle, 1976). In this paper I will review what little is known about the butterfly industry, the ecology of butterfly populations, and the status of conservation efforts on the island.

The Island and Its Butterflies

Taiwan is one of a chain of islands edging the Asian continent. About 145 kilometers from mainland China, the island is 385 kilometers long, 145 kilometers wide at the widest point, and 35,960 square kilometers in area. Massive and rugged mountains occupy the eastern half of the island from north to south. More than 60 peaks are over 3,000 meters in height, the highest being Yu Shan (Mt. Morrison) at 3,950 meters. The island straddles the Tropic of Cancer (23.5° N. Lat.) but, because of the high mountains, it exhibits a wide variety of climate/habitat associations, from tropical monsoon forests to rocky snow-capped mountains in winter. Rainfall varies from less than 1,000 to more than 6,000 millimeters per year, depending on locality. The population of approximately 16 million people is concentrated in the lowlands, but increasing numbers are now living in the mountains.

Although small in size relative to continental land masses, Taiwan has a diverse lepidopteran fauna which doubtless exists because of the diversity of habitats and isolation from mainland populations. Okano (1959) listed 269 species of butterflies and moths. Shirozu (1960) listed 361 species belonging to 161 genera and 11 families. Many of the genera are monotypic.

History and Development of the Industry

Unno (1974) has sketched the development of the butterfly industry in Taiwan. Collecting of Lepidoptera reportedly began in 1880 when a professor at Hokkaido University undertook studies of them. At that time, Taiwan was under the control of China. In 1895, Taiwan came under the direct rule of the Japanese empire for the next fifty years, and Japanese influence began to increase.

At the beginning of the twentieth century, the Meiwa Insect Research Institute in Japan proper established the Kisei Insect Collection Center in the town of Puli (Nantou Co.), Taiwan. This marked the start of commercial interest in the production and sale of decorative handicrafts made from butterfly wings.

Puli has remained a center for the butterfly industry up to the present, and the industry itself has flourished since the island was returned to the Chinese in 1945. Now, according to the Chinese (Chung Hwa) Information Service (CIS, 1975a), the industry provides a livelihood for about 20,000 people, including many factory workers and 10,000 collectors, of whom 2,000 were termed "professional." According to CIS, about 20 million butterflies are caught each year and sold to more than 30 factories. This estimate may be conservative, as about 15 million butterflies were reportedly handled each year by the Kisei Center alone (Unno, 1974).

Mrs. Chang Pi-Tzu, a Taiwan butterfly dealer, advertises her stock of "some millions" of insects in the *News of the Lepidopterists' Society* (Pyle, 1976: 285). The Great Taiwan Enterprises Company, Ltd., of Taipei mails out a price list for hundreds of species of butterflies, moths, and beetles. Prices range from US $.02 for one *Papilio machaon sylvina* Hemming (Papilionidae) to US $45.00 for each *P. marahao* Shiraki & Sonan (Papilionidae).

Manufacturing Process

According to Unno (1974), a factory may employ up to 50 workers who sit in rows at tables on which are placed piles of butterflies, perhaps as many as 10,000 in one pile. The wings are removed from the body and attached to an artificial body made of paper. Artificial antennae are made of pig bristles. The real bodies are collected and fed to pigs, a typical example of Oriental thriftiness in which everything

*Permanent address: 3761 Park Avenue, Coconut Grove, Florida 33133, USA.

is recycled. A single workshop may process 2,000 butterflies a day.

The butterflies, thus prepared with artificial bodies and real wings, are mounted between two thin layers of transparent plastic. In this form they are then used to decorate handbags, purses, food baskets, or become placemats, coasters, bookmarkers, wall decorations, etc. Maps of the island and life-like caricatures of human heads are also made with butterfly wings.

Other Uses

Quite apart from their use as handicraft novelties, butterflies in Taiwan have recently been shown to have potentially significant medical value. The wings of *Catopsilia crocale crocale* Cramer (Pieridae) were discovered to contain a rare chemical which appears to be effective as an anti-tumor agent in experiments on laboratory rats (Brewer, 1976). In order to obtain sufficient substance to conduct the first tests and to develop a synthetic equivalent, a quarter of a million butterflies of this species were collected in Taiwan under the aegis of the National Cancer Institute (Brewer, 1976).

A curiosity which has attracted local interest in Taipei is the Cheng Kung Insect Museum, popularly known as the "Butterfly Palace." The ceiling, walls, tables, chairs, and door knobs of this building are decorated with butterfly wings arranged in different designs (CIS, 1975a). According to CIS, 40,000 wings of 105 "varieties" of butterflies were used in the decor. The museum also reportedly displays "more than 30,000 different insect species" and most of the "major varieties" of butterflies in the world.

Capture

Anyone who has visited the countryside in Taiwan in spring or summer has probably seen children with butterfly nets patrolling fields, woods, and paddy edges. Catching butterflies is a popular activity, but serious collecting for commercial purposes uses more systematic and effective means of capture. Butterflies are attracted to stretches of wet, urine-soaked sand along mountain streams and rivers. The sand gives off a strong smell of ammonia which the butterflies seek out. They congregate in numbers to get at the substance, and a patient collector may catch as many as 500 in a single morning (Unno, 1974).

Impact of Industry on Butterfly Populations

Considering the enormous numbers of butterflies caught each year, it might seem advisable to halt all collecting on grounds that the butterflies may otherwise be driven to extinction. This approach may be emotionally satisfying, but it is not scientifically valid. As Pyle (1976: 285) pointed out, "The essential question . . . must be, to what extent does this trade impair populations of the insects so exploited?" Butterfly populations must be evaluated on a species-by-species basis, recognizing that collecting for the industry will have a varying impact on different species, depending on the biology and the market demand of each.

Unno (1974) noted that females of the species he observed in Taiwan were not attracted to the urine-soaked sand. Only males were caught. This could have important management implications. Under differential exploitation of males, viable populations could theoretically be maintained if each surviving male were able to service two or more females, and/or if males were to mate before their capture. Therefore, the collection of large numbers of butterflies per se may not necessarily impair the population of a species if it is promiscuous. Unno's observations in Taiwan may have reflected this mating and harvesting system.

An important ecological factor that can have a serious impact on butterfly populations is destruction of habitat. It is well known that many species of Lepidoptera have specialized habitat requirements and live in very localized areas (e.g., Shapiro, 1969; Ikezawa, 1974; Oppewall, [1976]; Dirig & Cryan [1977]; Orsak, [1977]). One can expect that when the habitats of such species are destroyed the species themselves will disappear, unless they are able to adapt to other habitat types.

Destruction of habitat is occurring widely in Taiwan today. Most of the original tropical and subtropical forests of the island's lowlands were removed over the last 300 years as the island's human population grew, first through immigration and colonization and then through increased population growth rates. Today, the virgin hardwood and coniferous forests of the mountains are also being cleared. Hardwood forests are the most seriously threatened because they are found at low elevations (generally below 2,000 meters in the north and 2,300 meters in the south). These previously undisturbed lands are now under the heaviest pressure for conversion to meet increasing human needs. Schultz (1970: 41) recommended that "all the remaining" primary (natural) hardwood forests of the island be logged and converted to faster growing conifer plantations by 2,000 A.D. (except for inoperable areas or those used for watershed protection). As fas as I know, this policy is still being pursued.

Aside from forestry practices, previously undisturbed mountain lands are being converted for agriculture (shifting and permanent), mining, power generation, tourism and recreation, transportation (roads, railroads), and human settlement (Severinghaus, 1977). Given these circumstances, scientists and conservationists should be concerned about the future of the island's flora and fauna, especially those species that may have specialized habitat requirements like the Lepidoptera. Most of the island's butterflies occur within the altitudinal range of the hardwood forests (0-2,300 meters), the same areas which are most severely disturbed or threatened by humans. In evaluating the status of butterflies in Taiwan, therefore, one needs to investigate the impact of habitat destruction on species populations. Destruction of critical habitat is probably more important in causing population decline and extinction than the collection of too many individuals.

Conservation Efforts

Butterfly conservation efforts in Taiwan need to focus on four basic elements: the ecology of individual species, the economics of the industry, mechanisms to implement management recommendations, and the cultural attitudes of the people toward nature. The latter may seem irrelevant, but an understanding of these attitudes among the Chinese (and Oriental people in a broader sense) is important for anyone advocating conservation policies. Inhabitants of Western

countries frequently feel that the Chinese people epitomize harmony between man and nature. As Brewer (1976: 54) wrote, "Western man can, without qualm, catch and kill a butterfly. A Chinese would rather contemplate it." This feeling is understandable, given the writings of early Taoist philosophers such as Chuang Tzu, who dreamt he was a butterfly (Baskin, 1972), and the magnificent Chinese landscapes showing tiny people surrounded by towering, cloud-capped mountains and thundering waterfalls. Yet this harmony expressed in philosophy and art is not consistent with present or historical reality and appears to me to represent an idealized abstraction created by the fertile minds of intellectuals across the ages. Intellectuals were in the minority, however. The common man in China has usually struggled against nature in order to survive and has seldom sought deliberately to maintain a state of harmony between himself and nature. Survival came first, and nature's resources were exploited to that end. Although it is true that *some* Chinese people would rather contemplate a butterfly than kill it (as would some westerners, too), these attitudes give way to the practical necessities of life, as evidenced by the butterfly industry itself in Taiwan.

Butterfly conservation in Taiwan today is, therefore, a socio-economic problem as well as a biological one. The industry is probably worth many millions of US dollars in domestic and foreign sales each year and provides a livelihood for tens of thousands of people. Yet no detailed study has ever been done of the economic and social benefits which the people of Taiwan derive from it. Nor has this been done for any of the island's other fauna. Given the great value of wildlife resources in Taiwan and the extent to which they are exploited, I strongly recommended to officials of governmental agencies responsible for wildlife that such a study be carried out (Severinghaus, 1977), on the assumption that an appreciation of the great economic potential in properly managed wildlife resources would contribute to their conservation. I urged this action at a seminar on 24 July 1974 in Taipei. To the best of my knowledge, this recommendation has been shelved, as have most recommendations relative to wildlife made over the years by various people (Severinghaus, 1977).

At the same seminar, I presented a position statement on wildlife. The only wildlife currently receiving legal protection in Taiwan are birds and mammals. I proposed a definition of wildlife that would include all major groups, including the Lepidoptera, which are exploited for commercial or other purposes in Taiwan. I hoped that this would draw governmental attention to the great diversity of wildlife being exploited and might serve as a guideline for their conservation. This suggestion has also been ignored as far as I know.

However, the government is not completely unaware of the butterfly resource, as evidenced by three articles in two years on the subject by CIS (1975a, 1975b, 1977). The Directorate General of Posts issued a set of butterfly stamps in four denominations in July 1977 (CIS, 1977). The government is also aware of the dangers posed to the resource by the continuing development of the island and indicated that "the authorities" are concerned. According to CIS (1975a), more than a dozen "butterfly farms" have been established "to preserve and cultivate rare and high quality species." CIS (1975b) also reported that a "breeding ground" for butterflies was to be established in the spring of 1976 at Lishan (Taichung Co.) by Mr. Chen Wei-shou, a high school biology teacher in Puli. Lishan is a mountain resort with a temperate climate and vegetation at about 2,000 meters elevation. Most of the native forests of the area have been clearcut and replaced with orchards of temperate-growing fruit. Chen and resort personnel were to transplant some 6,000 flowering plants to Lishan "to attract the 100-odd species of butterflies frequently found in the vicinity . . . and to support butterfly larvae and pupae." I do not know whether this plan was actually carried out and, if so, whether it was successful.

In summary, the government in Taiwan is aware in a general way of the economic and scientific value of the island's butterflies. However, government officials have not, to my knowledge, taken any action to study the economics of the industry and the ecology of butterfly populations, nor to offer legal protection and management schemes for the insects.

Acknowledgements

I would like to thank Robert Dirig for reviewing the first draft of this paper and for offering helpful comments. I am also grateful to Janice Ricardo for typing it.

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Notes

The Role of Education in Butterfly Conservation and its Application to the Bright Blue Copper Butterfly (*Lycaena heteronea clara;* Lepidoptera: Lycaenidae) of Southern California

The field of invertebrate conservation is neither as sophisticated nor as popular as vertebrate conservation. A vital part of invertebrate conservation is informing and educating the general public about endangered, threatened, and rare butterflies, and heightening a general appreciation of butterflies. Public agencies and other conservation organizations must also be made aware of the existence of rare and endangered butterflies and the locations of their populations. The United States Office of Endangered Species and the Xerces Society, however, together can only do so much to meet this immense educational need. Although both can maintain a liaison with other conservation groups and provide information on butterfly populations to public agencies for use in land management decisions, public education will almost certainly have greater success if pursued at a "grass roots," individual level.

The research goals and results of the Bright Blue Copper project, directed toward the Bright Blue Copper Butterfly (*Lycaena heteronea clara* Hy. Edwards), have been previously described ([1977], Atala 4(1-2): 10-18). Although the primary goal of the project was to collect data needed to formulate habitat management recommendations for populations of the butterfly, public education was also an integral part of the work during both 1975 and 1976. I will describe here the ways in which I went about informing the general public and public agencies about the existence and status of the butterfly, since these methods might be applied in enhancing awareness of other butterflies in other places.

Since people are naturally more interested in the wildlife occurring near their homes — wildlife that they can personally observe and appreciate — arousing interest in *local* butterflies is not very difficult. Local support is impossible without local awareness, and without local support for the butterfly, it would indeed be difficult to prevent further decimation of populations. It may well be, however, that in the case of the Bright Blue Copper my job of educating the local residents was made easier, since this work took place within the critical habitat of the California Condor, a very large bird with a remaining population of 40-50 individuals. Thus, residents were already aware that there was an endangered species in the area, and that the surrounding natural lands were rather unique.

I approached the problem of local public education on several levels. In 1975, prior to initiating the field research, I wrote a short article on the butterfly for the local newspaper (1975, Rare Butterflies in our Backyard, The Mountain Enterprise, 18 April: 7, 12). This was the first step in alerting the public that the Bright Blue Copper existed; I was aware, however, that most readers would probably quickly forget any details about the biology or behavior of the butterfly. While carrying out the actual field work, it was never difficult to attract local residents to the scene – people (sometimes law enforcement officers) were often curious about my daily presence (with or without an insect net) in the field, and would approach and ask what I was doing. When this happened, I told them about the butterfly and its localized occurrence. It is important to remember that with this initial contact with local residents, one can either enhance or destroy one's efforts to create awareness and interest in the rare organism. The educational effort is enhanced by obliging the inquirer with a polite and intelligible answer. It can be destroyed with either a look or tone of voice which says "I'm really too busy to give you an answer." Also, bear in mind that you are trying to "sell" the butterfly, not yourself, and thus you do not have to demonstrate your command of scientific vocabulary. It is essential that your reply not be garbled with technical jargon or scientific names that obviously no one but an entomologist would be able to understand. Interest in the organism tends to increase if the more interesting aspects of its biology are related. Finally, if you can actually show the local resident the organism, you will do a great deal to enhance interest and further curiosity.

Although I was able to talk to many local people during the 1975 study, I was aware that most of what I had told them would probably be quickly forgotten, although they would probably always remember that there was a rare butterfly in the vicinity. In order to provide a permanent source of reference for these people, I prepared a two-page "fact sheet" on the butterfly prior to the 1976 studies; this detailed the Copper's distribution, habitat, behavior, and biology, and included line drawings of the male and female.

It is difficult to appreciate any one aspect of science or nature (in this example, the Bright Blue Copper Butterfly) without a general appreciation of the whole field. A general appreciation of this sort is invariably nutured early in life. Hence, I was always responsive to children's questionings. It is most important to speak at their level when answering their questions. I always tried to give children some feeling for the necessary "links" between all the organisms in the ecosystem inhabited by the Bright Blue Copper — between butterfly and plant, plant and climate, and so on. Three local children aged 10-12 were particularly fascinated by my work. Their interest and enthusiasm gave me the idea of letting them participate in one aspect of the project which required little skill, but with which I could use help — staking out populations prior to mapping the vegetation in the area. Involving these children in the work was rather an experiment in itself, and a somewhat risky one, since I was on a relatively tight

schedule and could not easily make up for any wasted time which conceivably could have resulted. Fortunately, they were good workers, and I was most pleased with the results. In fact, I later solicited their help in searching for eggs on the hostplant for use in some later laboratory studies. The children were able to participate in an aspect of the project, enabling them to gain an insight into what scientific investigation is like, particularly regarding the amount of routine work that is often part of an experiment, and to learn that results are often not clear-cut.

Obviously, I could not personally interact with every local resident. This was particularly true since I was often studying populations far from the towns in the area. Thus, when the local newspaper contacted me near the end of both my 1975 and 1976 studies for a story on my work, I was happy to oblige. In this way, many more people could be made aware of the butterfly, and hopefully made to realize that it must be "mighty rare," "mighty interesting," or "mighty important" if someone was spending so much time observing and studying it. Of course, they might also have thought that I was "mighty crazy" to be wasting so much time and effort on a butterfly. However, I never personally observed the latter reaction. These people are invariably proud of where they live, and were always eager to learn that something was found there and nowhere else.

The final step in creating awareness for the Bright Blue Copper Butterfly was to inform both public agencies and private individuals who managed or owned land where populations occurred of their existence and location. It is obvious that there is no way a population of any rare organism can be preserved if the land owner or overseer does not even know it exists. Public agencies (the United States Forest Service, in this instance) are often very responsive to information on rare and endangered organisms inhabiting lands which they manage; land management plans will generally thereafter take these organisms into consideration. Private land owners are also often willing to spare a population as long as it does not create economic hardship. In notifying either public agencies or private land owners, it is, of course, imperative that you avoid exaggerating the plight of the organism — this both for reasons of personal honesty and also to maintain your credibility. If you exaggerate, it may catch up with you eventually, and the result could be the destruction of important populations. *Exact* locations of populations should always be given, using topographic maps if possible. Also it is wise to provide names and addresses of other people who can verify your statements on the organism. Thus far, I have contacted four individuals whose property harbors populations of the Bright Blue Copper, and have notified the Forest Service of those populations located on their land.

There is an unfortunate but natural tendency for scientists of all kinds to isolate themselves from the public, associating and sharing their findings only with other workers in their field of interest. This is not fair to the general public, since oftentimes these same scientists derive research funds and/or salaries from tax monies. It is particularly unfortunate, since the less the public knows about scientists' work, the less likely they may be to vote additional tax dollars to research. On the other hand, it is often difficult to justify basic research to members of the public, who all too often ask "What good is it?" In the course of my study, however, I never received this sort of reaction, even though I talked with people from all walks of life — ranchers, realtors, housewives, and forest rangers, to mention a few.

When rare, threatened, or endangered organisms are being studied, it is imperative that support of the local public and local conservation groups be gained if the destruction of populations of that organism is to be averted. Answering the questions of curious onlookers in a polite and intelligible manner hardly takes time away from research, and the long-term rewards may well be worth the minimal time and effort spent.

During the Bright Blue Copper Butterfly study of 1975-1976, public awareness education was a vital part of the project. There have been two immediate clear-cut successes resulting from these efforts. Mr. and Mrs. Doug MacBeth of Frazier Park, California, decided, after being informed that a Bright Blue Copper population flew on their property, to move the future site of a volleyball court to spare as much butterfly habitat as possible. Their decision, I am sure, was influenced by the fact that I spent a good deal of time on their property studying this population. Likewise, Mr. Donald Tait of Northridge, California, who owns a ranch in the Frazier Park area, has expressed interest in visiting and examining the fairly sizeable Bright Blue Copper population on his property. The United States Forest Service has also expressed interest in obtaining as much information as possible on the butterfly, for use in their land management decisions. Of course, long-term impacts resulting from my efforts cannot be determined at present.

I conclude with a recommendation: Share your information on butterflies with others, particularly with those who know little about them. In addition, share your information with conservation groups and public agencies which have the power to influence land management decisions in favor of the butterflies. The Xerces Society can have virtually no impact in butterfly education and appreciation without the *active* participation of its membership in this important process. Next time you are watching, collecting, or studying butterflies (or any other aspect of nature, for that matter) and someone approaches and asks what you are doing, reciprocate by letting them know. It will take little effort on your part, and it may help to make an appreciation for nature and the environment more widespread.

Larry J. Orsak, 2124 Blake No. 9, Berkeley, California 94704, USA

Book Review

Maritime Entomology

Marine Insects, **edited by Lanna Cheng; xii + 581 pp., illustrated; 1976. North Holland/American Elsevier Publishing Company, 52 Vanderbilt Avenue, New York, New York 10017, USA. $62.50.**

Marine Insects is a major contribution to a generally neglected field of study, the insects associated with the marine environment. In this book, marine insects are defined as those which spend at least part of their lives in association with "more or less saline waters." This volume is intended as a thorough survey of marine insects, which are usually dismissed as being few in number and of minor importance. However, as demonstrated in this book, the insects which are adapted to the marine environment are really quite diverse and offer many interesting problems worthy of future research.

The volume consist of nineteen chapters written by authorities in various fields. The chapters in the first part of the book treat topics of general interest, while those in the second part consist of a systematic review of major taxonomic groups. Each chapter has an extensive bibliography, making the book especially useful as a guide to literature. Subject and taxonomic indices are also included.

Chapters of general interest include "Insects in marine environments" by L. Cheng, "Insects of marine saltmarshes: problems and adaptations" by W. A. Foster and J. E. Treherne, "Respiratory adaptations of marine insects" by H. E. Hinton, and "Insect parasites of marine birds and mammals" by M. D. Murray. J. Bowden and C. G. Johnson treat "Migrating and other terrestrial insects at sea," which mainly concerns windblown terrestrial insects. Centipedes, symphylids, pauropods, millipedes, scorpions, whipscorpions, pseudoscorpions, mites, and spiders are treated in "Other intertidal air-breathing arthropods" by V. D. Roth and W. L. Brown.

The bulk of *Marine Insects* deals with the various insect groups. Each chapter gives a general introduction to the group under discussion, their characteristics, ecology, life histories, marine adaptations, and systematics. As is to be expected in an anthology, coverage varies from chapter to chapter, with some authors emphasizing ecology, others taxonomy. The following subjects are covered: "Littoral apterygotes (Collembola and Thysanura)" by E. N. G. Joosse; "Water-striders (Hemiptera: Gerridae, Veliidae, etc.)" by N. M. Anderson and J. T. Polhemus; "Shore bugs (Hemiptera: Salididae, etc.)" by J. T. Polhemus; "Water-boatmen of saline waters (Hemiptera: Corixidae)" by G. G. E. Scudder; "Marine caddis flies (Trichoptera: Philanisidae)" by J. P. Leader; "Saltmarsh mosquitos (Diptera: Culicidae)" by G. F. O'Meara; "Biting midges of mangrove swamps and saltmarshes (Diptera: Ceratopogonidae)" by J. R. Linley; "Non-biting midges of marine habitats (Diptera: Chironomidae)" by H. Hashimoto; "Horse flies and deer flies (Diptera: Tabanidae)" by R. C. Axtell; "Seaweed flies (Diptera: Coelopidae, etc.)" by T. Dobson; "Shore flies and brine flies (Diptera: Ephydridae)" by K. W. Simpson; "Marine beetles (Coleoptera excluding Staphylinidae)" by J. T. Doyen; and "Intertidal rove beetles (Coleoptera: Staphylinidae)" by I. Moore and E. F. Legner.

Despite the thorough coverage of the above mentioned groups, several insect groups are omitted in the text, with only a brief mention in the preface. A large cosmopolitan marine earwig, *Anisolabis maritima* (Gene), is overlooked, along with other earwigs found on beaches. Other groups not included are Hymenoptera, Homoptera, Neuroptera, and several families of Diptera. Perhaps these groups can be treated in a future revision; their inclusion would add greatly to the overall usefulness of the book.

Marine Insects will hopefully stimulate further research in this interesting field, and it provides an excellent base for such studies. This book should also be helpful in environmental assessment of human impact on the marine environment. Reports such as the "environmental impact statements" required for development of coastal areas in California generally ignore insects. It is unfortunate that the high price of this book will not allow many interested individuals to purchase it.

SCOTT E. MILLER, Santa Barbara Museum of Natural History, 2559 Puesta Del Sol Road, Santa Barbara, California 93105, USA

Abstracts of Recent Literature

Recent and previously overlooked papers dealing with the conservation of terrestrial arthropods and their habitats are briefly summarized in this column. Beginning with this issue, articles dealing with preservation theory and its application to any threatened or endangered organism are also abstracted here. These articles should benefit those working on arthropod conservation problems. Suggestions, references, and reprints, especially from local sources, are requested so that this compilation can be of maximal use. A photocopy of any paper abstracted in this column may be obtained at cost (US 5¢ per page, postpaid) from the compiler, Larry J. Orsak (address on inside back cover).

Politics and Issues

Dabrowski, J. S. 1977. O ochronie zwierzat bezkregowych [On the protection of invertebrate animals]. Chronmy Przyr. Ojczysta [Polish Academy of Sciences—Nature Protection Research Center] 33(2): 19-25.

The author expresses concern over the continuing decline of nearly all the invertebrates placed under protection 22 years ago in Poland. Such declines have occurred even in national parks and nature reserves. The explanation for this is complex, involving the following factors: (1) Only one out of 600 nature reserves in Poland has been established to safeguard the invertebrate fauna. (2) Only 0.53 percent of the land in Poland is currently protected. (3) Virtually all existing nature reserves are of minimal size and are without buffer zones. (4) Accidental and intentional chemical pollution occurs in most national parks and nature reserves. (5) Mercury vapor lamps in several national parks may affect populations. The author discusses the endangered *Parnassius apollo* butterfly and its almost total extermination in the Pieniny range and severe reduction in the Tatry mountains, due to a lack of understanding and ignorance of the importance of the problem by national park personnel. The author expresses the need for more active protection in nature reserves, based upon complex research supported and supervised by local authorities.

Ziegler, J. B. 1976. Lepidoptera and the Endangered Species Act of 1973. News Lepid. Soc. No. 6 [20 December]: 8, 9.

Orsak, L. J. 1977. Lepidoptera conservation and the Endangered Species Act of 1973—a different viewpoint. News Lepid. Soc. No. 2 [March/April]: 2, 24.

Ziegler questions the effectiveness of the United States Endangered Species Act (ESA) in the conservation of Lepidoptera, focusing on "the potential impact of the Act on the collecting activities of both professional and amateur lepidopterists." He feels that current regulations may sanction collecting of endangered butterflies for museums, while prohibiting private collectors from doing the same. Ziegler uses a hypothetical example to illustrate the possible implications of the "similarity of appearance" clause of the ESA. He concludes that applying the ESA to insects is misguided, "is not in the public interest, and is not in the interests of lepidopterists, especially insofar as said application interferes in any manner with the right of lepidopterists to collect." The article by Orsak is a rebuttal of Ziegler's. Orsak expresses more optimism that the ESA can work to save remaining populations of declining butterflies. He upholds the idea that endangered entities already occurring in national parks or other "protected" areas still merit placement on the list. He feels that the collecting restriction of the ESA for some endangered butterflies is probably not warranted; for others it probably is. The current collecting restrictions on both common and rare organisms in national and most state parks is questioned, since Orsak feels this is a far greater—and less warranted—threat to the so-called "right to collect" than the collecting restriction of the ESA on endangered butterflies. He also expresses doubt that the Xerces Society or any other conservation group will be cast in the role of prosecutor of poaching collectors, using the "similarity of appearance" clause of the ESA.

Biogeography and Faunistics

Bousfield, E. L., & F. G. Howarth. 1976. The cavernicolous fauna of Hawaiian lava tubes. 8. Terrestrial Amphipoda (Talitridae), including a new genus and species with notes on its biology. Pac. Insects 17: 144-154.

One in a continuing series of papers on this unique ecosystem. The authors consider this new species of terrestrial crustacean to be rare or endangered, due to its exceedingly localized distribution and corresponding susceptibility to habitat destruction and/or over-collecting.

Powell, J. A. 1976. A remarkable new genus of brachypterous moth from coastal sand dunes in California (Lepidoptera: Gelechioidea, Scythrididae). Ann. Entomol. Soc. Am. 69: 325-339.

Areniscythris brachypteris, endemic to the Marina dunes of San Luis Obispo County, is described, and its biology and behavior discussed. Other insects endemic to this dune system are the robberfly *Ablautus schlingeri* and the grasshopper *Trimeritropis pogonata*. Ten plants are also endemic to these dunes, parts of which have already been severely altered by off-road vehicle activity.

Schlauch, F. C. 1977. The Pine Barrens: our forgotten responsibility. LI 1977 (10 July): 6-9, 20. [*In* Newsday 37(301).]

The Long Island Pine Barrens is described and its present status on Long Island, New York, summarized. Rare lepidopterans inhabiting the Pine Barrens include Hessel's Hairstreak (*Mitoura hesseli*) and the Buck Moth (*Hemileuca maia*). Present threats and needed management practices are described.

Toriakson, T. 1977. Last chance to save Antioch Dunes ecosystem. Yodeler (Sierra Club, San Francisco Bay Chapter), July issue: 1, 12.
The current status of the habitat supporting the endangered Lange's Metalmark Butterfly (*Apodemia mormo langei*), as well as other rare and endangered plants and insects (ten endemic insects alone), is summarized. Past and present efforts to save the remaining tracts are discussed; the high market value of this industrial-zoned land (from US $20,000. to US $45,000. per acre [1.0 acre = 0.4 hectare]) has prevented its preservation to date, although there are hopes to purchase 15 acres from a private owner and lease an adjacent ten acres of power line right-of-way.

Populations, Ecology, Habitats, and Management

Orsak, L. J. 1976. Endangered Bay area butterflies. Yodeler (Sierra Club, San Francisco Bay Chapter), December issue: 6.
Brief summaries of the status, distribution, and biology of the endangered California butterflies *Apodemia mormo langei, Lycaeides argyrognomon lotis, Plebejus icarioides missionensis, Callophyrs mossii bayensis,* and *Shijimiaeioides enoptes smithi,* all found in the general proximity of San Francisco Bay, are presented. Special emphasis is placed on the importance of habitat preservation of the proper type in order to prevent further decline of these organisms.

Endangered and Rare Organisms—General

Terborgh, J. 1974. Preservation of natural diversity: the problem of extinction prone species. BioScience 24: 715-722.
The author discusses how reserves do and do not help in the effort to prevent species loss from exceeding species gain (i.e., through evolution). Data are presented which show species loss which has occurred on present-day islands, since they became isolated from the mainland. Data are also presented for Barro Colorado Island, a Panamanian Smithsonian Reserve which became an island in a lake in about 1914. The data show a loss in diversity in 50 years, analogous to the loss occurring on islands separated from the mainland. This information indicates that small island-like preserves may not be sufficient to preserve species diversity, even in the absence of actual habitat disruption. The author finishes with a list of several "types" of species, with a prescription for the preservation of each: (1) *Species on a high trophic level, and largest species:* Prohibit hunting in most cases. Large reserves are important, although protection outside reserves is necessary, since the animals may often forage outside reserve boundaries. (2) *Widespread species with poor dispersal and colonization abilities:* Medium-sized to large reserves are necessary, which include a maximum diversity of vegetation types. (3) *Continental endemics:* Often endangered unintentionally, due to lack of public awareness. Research needed to identify pockets of endemism. Small reserves are often sufficient for protection. (4) *Oceanic islands endemics:* Careful restraint on introduction of exotic plants and animals essential; reserves are important, but more research is needed to investigate the fragility of the island ecosystem. (5) *Species with colonial resting habits:* "Locate active nesting grounds and protect them." Small land reserves may be sufficient for the protection of thousands of individuals. (6) *Migratory species:* Both summer and winter grounds must be protected. More research is needed to define winter ranges and habitats of Americans migratory species.

U.S. Office of Endangered Species—Proposals and Rulings

Greenwalt, L. A. 1975. United States butterflies—review of status. Fed. Regist. 49(55): 12691. [20 March issue.]
Forty-two butterflies, primarily Californian, are listed for review to determine whether they should be proposed for listing either as endangered or threatened species.

Greenwalt, L. A. 1975. Endangered and threatened wildlife—proposed threatened status for two species of butterflies. Fed. Regist. 40(78): 17757. [22 April issue.]
The Schaus (*Papilio aristodemus ponceanus*) and Bahaman (*P. andraemon bonhotei*) Swallowtails are proposed as threatened species; factors currently threatening populations are summarized.

Greenwalt, L. A. 1975. Proposed endangered status for 6 species of butterfly in California. Fed. Regist. 40(199): 48139.
Present distribution and current threats to the following butterflies are briefly summarized: *Callophrys mossii bayensis, Lycaeides argyrognomon lotis, Icaricia icarioides missionensis, Philotes* (or *Shijimiaeoides*) *enoptes smithi, Shijimiaeoides battoides allyni,* and *Apodemia mormo langei.*

Greenwalt, L. A. 1976. Endangered and threatened wildife and plants—determination that two species of butterflies are threatened species and two species of mammals are endangered species. Fed. Regist. 41(83): 17736-17740.
Schaus and Bahaman Swallowtails (*Papilio aristodemus ponceanus* and *P. andraemon bonhotei,* respectively) are designated threatened. Comments of the public which were obtained in reference to the proposed ruling are summarized. The ruling is made that adult specimens of either species may be taken without a Federal Permit, as long as this is not in the course of a commercial activity and as long as other laws (e.g., National Park Service regulations) are not violated.

Greenwalt, L. A. 1977. Endangered and threatened wildlife and plants—proposed determination of critical habitat for six butterflies and two plants. Fed. Regist. 42(26): 7972-7975.
Location of proposed critical habitats is shown and described for the six U.S. endangered butterflies. Proposed critical habitat of the two plants is the same as that proposed for Lange's Metalmark Butterfly (*Apodemia mormo langei*), all three of which are endemic to remnant tracts of the Antioch dunes of Contra Costa County, California.

Greenwalt, L. A. 1976. Convention on international trade in endangered species of wildlife fauna and flora—proposed implementation. Fed. Regist. 41(117): 24367-24378.

Greenwalt, L. A. 1977. International trade in endangered species of wild fauna and flora—implementation of convention. Fed. Regist. 42(35): 10462-10488.

"The Convention establishes rules for the trade in endangered and other species of wild plants and animals between countries which are parties to the Convention." Butterflies protected by the Convention include the Mountain Apollo (*Parnassius apollo*) and the birdwing butterflies *Ornithoptera alexandrae, O. allotei, O. chimera, O. goliath, O. meridionalis, O. paradisea,* and *O. victoriae.*

Previously Overlooked

Dethier, V. G., & R. H. MacArthur. 1964. A field's capacity to support a butterfly population. Nature 201: 728-729.

Data are given which indicate, among many other things, a rapid recovery (within one year) of three colonial populations of *Melitaea harrisii* (based on egg counts) following the removal of large numbers of autumn larvae the previous fall. This evidence supports the belief that collecting has negligible effects on invertebrate populations.

Wildlife Data Storage and Retrieval

Dirig, R. 1977. Labelling and storing an insect collection. 4-H Members' Guide M-6-7: 1-21. [Cooperative Extension, N.Y. State College of Agriculture and Life Sciences, Cornell University, Ithaca.]

Dirig, R. 1977. Labels for insect specimens. 4-H Members' Guide M-6-7a: 1. [Cooperative Extension, N.Y. State College of Agriculture and Life Sciences, Cornell University, Ithaca.]

The "how's" and "why's" of labelling and storing insects are given to maximize the scientific value of collected specimens. The life history of the Karner Blue Butterfly (*Lycaeides melissa samuelis*) is illustrated via halftones to alert New York collectors to its protected status as an endangered species within the state.

Announcements & Notices

Xerces Society Fifth Annual Meeting

The Fifth Annual Meeting of the Xerces Society will be held at the Oakland Museum, Oakland, California, USA, on 19-21 May 1978. Four of the six butterflies currently listed as Endangered Species by the United States Office of Endangered Species occur in the greater San Francisco Bay area, in which Oakland is situated. A field trip is planned to view at least two of these endangered butterflies in their natural habitats. Nearby educational facilities include the California Academy of Sciences and the University of California at Berkeley. If you are interested in receiving additional information about the program, or if you would like to present a paper, please contact *Larry J. Orsak, Department of Entomology, 201 Wellman Hall, University of California, Berkeley, California 94720, USA,* as soon as possible.

Deadlines for Volume 6

All manuscripts and other material for the Volume 6, Number 1 issue of *Atala* should reach the Editor by *1 April 1978.* For the Volume 6, Number 2 issue, material should arrive before *1 October 1978.*

Acknowledgements for Volume 5

Gratitude is expressed to John F. Cryan, Larry J. Orsak, and Frederick C. Schlauch for their assistance in reviewing manuscripts submitted for Volume 5. Peter A. Hyypio advised on botanical nomenclature. Many helpful suggestions were made by members of the Xerces Society Editorial Policy Committee, Richard A. Arnold (Chairman), Paul A. Opler, and Jerry A. Powell. Members of my family assisted in the arduous but essential task of proofreading typeset copy.

Especial thanks to Francie Chew for her cover drawing for Volume 5, Number 2. John F. Cryan kindly assisted with the graphics, designed the "ATALA" cover logo, and drew the cover for Volume 5, Number 1.

Robert Dirig, Editor

SUGGESTIONS FOR CONTRIBUTORS

Formal scientific articles and notes dealing with any aspect of the ecology and conservation of endangered or threatened terrestrial arthropods are solicited. Articles will generally be longer papers, notes not exceeding 1000 words. Reviews of books dealing with terrestrial arthropod conservation or endangered habitats are also invited. Appropriate philosophical papers will be welcomed for use in the "Commentary" section.

All manuscripts should be typewritten on white, 8½ x 11 inch, good quality bond paper, on one side only, double- or triple-spaced throughout, with margins of at least one inch on all sides. The original typescript and at least one (preferably two) xeroxed or carbon copies should be submitted; authors should also retain a copy of manuscripts and figures for later consultation with the editors.

Please include illustrations if appropriate. Figures should be consecutively numbered in Arabic numerals. Hand-drawn figures should be rendered in black ink on good quality white paper. They may be larger than final reproduced size. Black and white glossy photographs may also be submitted. These and artwork will be returned after publication if accompanied by return postage. Figure captions should be typed, double-spaced, on a separate sheet, and the number of the figure lightly pencilled on the back of each drawing or photograph. A sketch map should be included as a figure with all articles or notes dealing in a major way with a specific region or arthropod habitat.

Cover art changes with each issue, and contributions will be gratefully received. Cover illustrations should generally show insects or other arthropods in *living* poses, and prospective cover artists should consult with the Editor before submitting material.

Tables should be numbered consecutively in Arabic numerals and submitted in photo-ready condition on separate sheets. Please include full scientific names, *with authors*, for both plants and animals mentioned in any manuscript submitted for publication in *Atala*. The metric measurement system should be used, with English system equivalents in parentheses if desired. Full references to literature cited should appear in a separate section at the end of articles or commentary papers, but should be parenthetically incorporated within the text of notes. Please include an *informative abstract* of approximately 150 to 250 words with all articles. Avoid footnotes to text statements if possible; such information can usually be included within the text. Words to be set in *italics* should be underlined. Reprints of articles are available at cost. An author will receive a reprint order form after acceptance of a manuscript. The style of *Atala* generally follows that recommended in the *CBE Style Manual* (1972). Abbreviations of journal titles follow *Bibliographic Guide for Editors and Authors* (1974).

Prospective authors may request a copy of the detailed editorial policy of *Atala* from the Editor.

COVER

The native Mustard White (*Pieris napi oleracea* Harris) has almost disappeared from southern New England. The primary cause is uncertain; habitat destruction is perhaps more likely than competition with the introduced Cabbage Butterfly (*P. rapae* (L.)), although all relevant data are not yet available.

The cover drawing depicts a mating pair of Mustard Whites in a sedge-alder swamp near Wolcott, Lamoille County, in northern Vermont. This butterfly is extremely abundant at this site, and many mating pairs were observed by the artist a few decimeters above the ground, resting on sedges (*Carex* sp.) or grass stems, as shown. The habitat contains large stands of native and introduced wintercresses (*Barbarea* spp.), and is surrounded by hayfields and spruce/mixed deciduous woodland in which toothwort (*Dentaria* sp.) occurs. The vegetation of this swamp is currently under study by the staff of the Center for Northern Studies in Wolcott, and although it was used for grazing cattle during the 1940's, it is unlikely that the area will be further disturbed in the foreseeable future.

The drawing was rendered using pen and ink by F. S. Chew, and is based on photographs of pairing butterflies and their habitat. See her article on crucifers and pierids in this issue.

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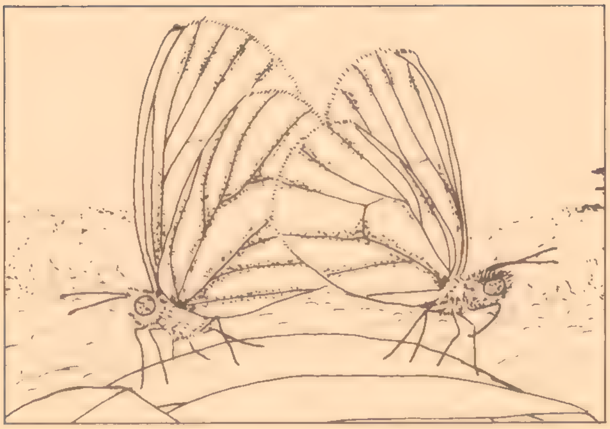

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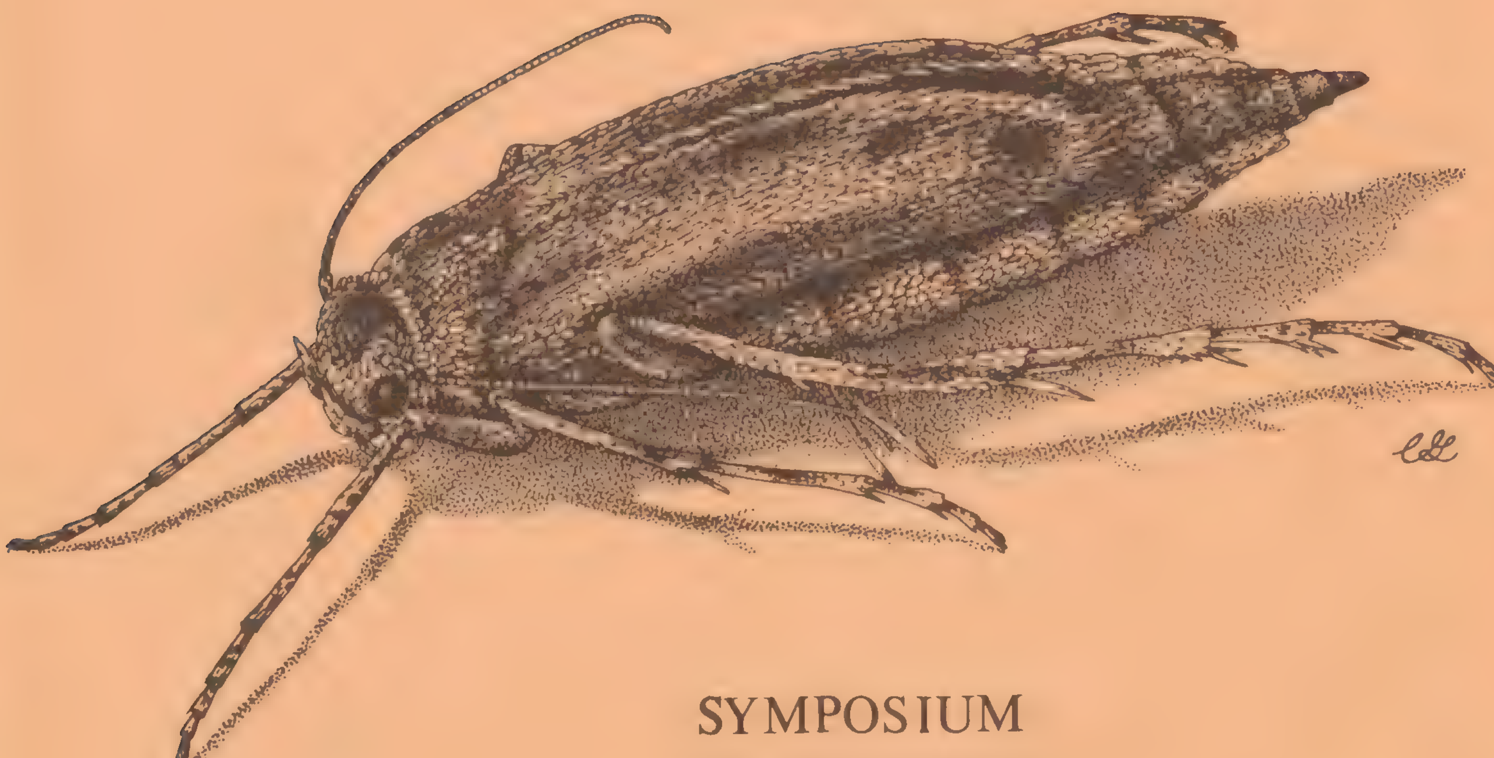

SYMPOSIUM
PROCEEDINGS

Volume 6, Numbers 1-2
1978(81)

THE XERCES SOCIETY

An international, non-profit organization dedicated to the conservation of terrestrial arthropods and their habitats. Named for the extinct Xerces Blue Butterfly, *Glaucopsyche xerces* (Boisduval). Founded on 9 December 1971.

MEMBERSHIP INFORMATION

Membership in the Xerces Society is open to all interested persons and institutions upon submission of appropriate dues. Adult memberships and institutional subscriptions are US $8.00 and student memberships are US $4.00 for the 1980 calendar year. All members and institutional subscribers normally receive the journal *Atala* twice yearly; the less formal newsletter *Wings* three times yearly; *Self-Help Sheets* (informal, how-to articles) and *Educational Leaflets* (short, informal, informational) irregularly, as they are issued; and Society meeting announcements, membership lists, and other communications. Xerces Society publication and administration costs are covered by dues and contributions, all of which are tax-deductible. A person or institution interested in receiving Xerces Society publications should submit name, address, and appropriate dues to the Treasurer, *Stephen Chang, 304 West 236th Street, Bronx, New York 10463, USA.*

Changes of address, requests for back issues of all publications, and general correspondence about the Society should be sent to the Secretary, *Terry Clifford, Department of Zoology & Physiology, University of Wyoming, Laramie, Wyoming 82071, USA*. Correspondence about terrestrial arthropod conservation issues, Xerces Society policies, and suggestions for *Self-Help Sheets* and *Educational Leaflets* should be addressed to the President, *Karolis Bagdonas* at the above University of Wyoming address. *Atala* contributions should be mailed to the Editor, *Robert Michael Pyle, Swede Park, Loop Road, Box 123, Gray's River, Washington 98621, USA*. Less formal items for inclusion in the Xerces Society newsletter *Wings* should be addressed to the Editor, *Lawrence F. Gall, 360B OML, Department of Biology, Yale University, New Haven, Connecticut 06520, USA*. Questions, comments or contributions to the annual Butterfly Count should be sent to the Butterfly Count Coordinator, *Ira Heller, 38 Laconia Street, Lexington, Massachusetts 02173, USA*.

Published at Los Angeles, California, USA, in April 1981, by the Xerces Society in cooperation with The Lepidoptera Research Foundation.

ATALA

JOURNAL OF THE XERCES SOCIETY

Volume 6 | 1978(81) | Numbers 1-2

"Endangered Insects of the World" Proceedings

Introduction to the Proceedings and an Update on Terrestrial Arthropod Conservation

Larry J. Orsak

Department of Entomology, University of California, Berkeley, California 94720, USA

Abstract

The importance of the first international symposium treating the conservation of terrestrial arthropods, which generated this proceedings, is noted. Reasons for protecting rare and endangered insects and their relatives are reviewed, followed by a synopsis of developments in the field since 1977, with primary emphasis on the United States. The review concludes with a plea for increased education of the general public in order to enhance public support for the protection of these organisms.

Introduction

During the past decade, the conservation of terrestrial arthropods has rapidly evolved to become a field of study on a truly world-wide basis. While the mere presence of this field may still mystify a generally unaware public-at-large, one must note that terrestrial arthropods—insects, arachnids, millipedes, centipedes and many crustaceans—comprise perhaps 79 percent of all animals (Elzinga, 1978) and an estimated 55 percent of *all* species, plants and animals (Daly, Doyen & Ehrlich, 1978). These statistics predict the immense importance of arthropods in world terrestrial ecosystems. Thus, recent moves to consider this organismic group in endangered species programs simply reflect, in a realistic way, their important profile among the earth's living organisms.

Prior to the Fifteenth International Congress of Entomology, held 19-27 August, 1976, in Washington, D. C. (USA), there had never existed an opportunity to bring together a respectable number of insect conservationists from more than one nation. The occasion finally arrived on the afternoon of 21 August[1] with the "Endangered Insects of the World" symposium, organized by Paul A. Opler of the Office of Endangered Species (United States Fish and Wildlife Service). Ten invited speakers from the United States and Great Britain participated[2], attracting a maximum attendance reaching 100, but averaging about 50. Not only did this event permit a long-awaited gathering of specialists, it symbolically demonstrated the legitimacy of terrestrial arthropod *protection* to an academic profession usually more concerned with arthropod *obliteration*.

Five years have passed since the symposium. Yet, in view of the historic significance of the meeting, it seemed worthwhile to publish the proceedings as Volume 4 of *ATALA*, a decision that also represents a pioneering event for the Xerces Society journal as a communications vehicle. Essentially, the papers herein review the 1976 "state of the art" of British and American endangered insect conservation programs, although authors were allowed to update their presentations through early 1978. Appended to the original ten presentations in this proceedings is the paper by Paul A. Opler. His article reviews specific progress made by the United States government in protecting that nation's insect fauna up to 1978; it was invited for inclusion here so that the proceeding's coverage of United States insect conservation would more accurately reflect progress of the field up to that time.

The purpose of this introduction is two-fold. First, it is my hope that the proceedings will be read by a great many individuals who are not familiar with terrestrial arthropod conservation. For the benefit of these readers, I will attempt to

[1]The symposium was preceded by an equally historic meeting at the Washington, D. C. World Wildlife Headquarters, from 16-19 August. This gathering marked the first meeting of the Lepidoptera Specialist Group (Survival Service Commission, International Union for the Conservation of Nature and Natural Resources). Comprised of knowledgeable lepidopterists from around the world, the goal of the Group is to identify critical issues in lepidoptera conservation and develop Action Programmes to protect these Endangered lepidopterans (Pyle, 1977, 1981a). It is safe to state that this meeting would not have occurred had it not been for the "Endangered Insects of the World" symposium, for which most of the Group's initial participants had traveled to Washington, D. C. It should also be noted that, as the first Specialists Group dealing with insects, spinoff Groups focusing on other insect categories have subsequently been created—a significant advance for terrestrial arthropod conservation.

[2]Two contributed papers immediately followed the symposium invited papers. These were: "The Schaus Swallowtail: Comments on its Ecology and its New 'Threatened' Status" by Charles V. Covell, Jr., and "Disappearance of the Atossa Fritillary Butterfly (*Speyeria adiaste atossa*) of Southern California" by Larry J. Orsak. Some information which comprised these presentations may be found in Covell (1978) and Orsak (1974), respectively.

summarize the complex answer to the simple question, "Why save an insect?" Although important to consider, this was a topic not generally touched upon by symposium participants, simply because they realized the legitimacy of their efforts. Following this discussion, I provide a review of continuing progress that has occurred since the symposium. I have done this by touching upon some of the more recent developments in the field. My synopsis will necessarily be biased towards events with which I am most familiar; those in the United States, particularly California. For a more complete review, the upcoming treatment by Pyle, Bentzien and Opler (1981) should be consulted.

Why Save an Insect?

Persons not associated with rare/endangered insect conservation often question the importance of saving these organisms, and criticize the (small) amount of money and energy being channeled into this conservation area. The simple fact that so many individuals, even conservationists, question the need for saving insects and their relatives is disturbing and indicates a continuing failure of entomologists and insect conservationists in making the general public aware of (1) the multifold beneficial contributions that insects have made to human society, and (2) the important roles of terrestrial arthropods in the world biosphere, of which we are a part. The question "Why save an insect?" can be answered on several levels. The reasons have been previously discussed (Anonymous, 1979a; Orsak, 1978; Pyle, 1976, 1978, 1979a), but merit reiteration.

Aesthetics and Education

On a very basic level, many insects are aesthetically pleasing and simply, "nice to have around" (Lipske, 1979). Butterflies are the outstanding example, with groups such as the swallowtails and birdwings (family Papilionidae) being especially notable. The prominence and beauty of insects may explain their historic importance in many human cultures (Brewer, 1976). For much the same reasons, insects have long functioned as important educational tools, particularly in nature interpretation programs. In this role, they do not necessarily have to fit the "aesthetically pleasing" criterion; species which are easily reared or collected, or which illustrate the tremendous diversity in organismic structure and behavior—evolutionary adaptations to particular environments—have great value as educational subjects. Indeed, insects as a group contain perhaps the best illustrative examples of the remarkable specializations evolved for successful survival in often-harsh environments (Cloudsley-Thomson, 1975; Cheng, 1976; Downes, 1965; Neumann, 1976). The flightless moth *Areniscythris brachypteris* Powell, illustrated on the cover and discussed by Jerry Powell in these proceedings, is a prime example.

Importance in World Ecosystems

On an ecosystem level, the importance of arthropods as major components of both terrestrial and fresh water aquatic foodwebs, indicates their contributing role in foodweb stability. They serve as food for many vertebrates and invertebrates, feed upon both plants and animals, or function as scavengers and major organic matter decomposers and "recyclers." Although one rare insect will not greatly affect foodweb stability, the presence of many arthropod species—rare and common—have significant effect. Yet, even individual or rare species play significant roles in ecosystems and can thus function as indicators of the stability of a foodweb or, more generally, as indicators of an ecosystem's health (Claasen, 1933). Such organisms often forecast subtle environmental changes derived from human activities. Jeremy Thomas, in his symposium paper, explains how the demise of the Large Blue Butterfly (*Maculinea arion* (L.)) was brought about by disturbances in the delicate foodweb connecting the butterfly, native ants, vegetation and vertebrate herbivores. Monitoring Large Blue populations enabled British entomologists to identify changes in a habitat which superficially appeared rather static.

The utilization of insects as ecological indicators, however, is not restricted to rare or even individual species. Comparisons of insect diversity and species abundance show increasing potential for habitat monitoring; for example in aquatic (Hilsenoff, 1977) and soil ecosystems (Edwards, 1969).

Importance for Food and Fiber Production

It is both unfortunate and inaccurate that the "importance" of an organism is so often defined solely as its direct value to the human species. Even in this narrow context, it can be demonstrated that terrestrial arthropods, particularly insects, hold tremendous actual and potential beneficial value to humans (Southwood, 1977). Although the negative aspects of insects as agricultural pests and transmitters of human disease are more often publicized, it has been estimated that only about 400-500 species in the United States ever cause serious economic damage (Subcommittee on Insect Pests, 1969); this represents approximately 0.5 percent of the estimated 91,200 known species for both the United States and Canada (Borror, DeLong & Triplehorn, 1976). The vast majority of terrestrial arthropod species are benign or beneficial.

One of the most beneficial attributes of insects concerns their role as pollination agents, since it has been estimated that over 65 percent of living flowering plants depend upon insect pollinators for reproduction (Axelrod, 1960). Without insects, many human crops simply would not exist (Free, 1970; Tepedino, 1979). Other insect species function as predators and parasites of agricultural pests, characteristics that biological control researchers hope to enhance, thereby resulting in reduced pesticide use and more stable agro-ecosystems (Huffaker & Messenger, 1976; Huffaker, 1980; van den Bosch & Messenger, 1973).

Insects are also direct providers of food, such as honey. As an abundant protein source, many cultures have made insects an important component of their daily diet, a habitat being encouraged but not yet prevalent in western society (Holt, 1885; Taylor, 1975).

Finally, insects have been used to obtain silk, wax, lacquer and shellac, and a variety of pigments and dyes (Metcalf, Flint & Metcalf, 1962).

Research Subjects

Terrestrial arthropods have proven to be exceedingly important research subjects, the beneficial implications of which too often seem unrecognized and unappreciated by the public. Using insects, biologists have made significant strides in understanding biological phenomena in an array of scientific disciplines. Classic studies with insects have resulted in major advances in the fields of *evolution* (Bishop & Cook, 1975;

Breedlove & Ehrlich, 1968; Bush, 1969; Dobzhansky, 1951; Ehrlich & Raven, 1964, 1969; Hamilton, 1964; Kettlewell, 1973; Trivers & Hare, 1976), including *mimicry* (Bates, 1862; Burns, 1966; Clark and Sheppard, 1963),*behavior* (Alexander, 1961, 1964; Alloway, 1972; Barth & Lester, 1973; Fraenkel & Gunn, 1961; Iwata, 1976; Schnierla, 1946; von Frisch, 1967, 1974), *physiology*, including *neurophysiology* (Fuzeau-Braesch, 1972; Hoyle, 1970; Parnas & Dagan, 1971; Roeder, 1967; Rudall & Kenchington, 1971; Saunders, 1976; Stobbart & Shaw, 1974), *cellular* and *organismic development* (Brooks & Kurtti, 1971; Gilbert & King, 1973; Gilbert & Schneiderman, 1961; Schneiderman, 1979; Strub, 1979; Whitten, 1968; Wigglesworth, 1966; Williams, 1963), *general ecology* (Andrewartha & Birch, 1954; Ayala, 1969; Birch, 1948; Breedlove & Ehrlich, 1968, 1972; Brower, *et. al.*, 1968; Feeny, 1970; Holling, 1965; Park, 1962; Schoonhoven, 1972; Southwood, 1978), and *population dynamics* (Morris, 1959, 1963; Pimentel, 1968; Varley, Gradwell & Hassell, 1973). In the field of *genetics*, beginning with Thomas Hunt Morgan's (1910) classic sexual inheritance paper, the ubiquitous fruit fly species *Drosophila melanogaster* Meigen became such an important genetics subject animal that it has been termed the "queen bee of genetics" (Brown, 1973). Fruit flies have since become important animals for *behavioral, population and evolutionary genetics* studies (Hotta & Benzer, 1972; Carson, 1970, 1974; Johnson, 1973; Lewontin & Hubby, 1966).Finally, the rapidly growing field of *sociobiology*, with its significance to the oft-debated nature/nurture (genetic versus environmental) influences on human behavior and intelligence, had its basis in studies of social insects (Wilson, 1975).

The knowledge acquired through insects in these biology fields is in no way esoteric. Consider the application of such information to (1) the study of genetic disease and abnormal cellular development, such as cancer, in humans (derived from insect genetics and developmental biology studies—see Clarke, 1967); (2) wildlife management, including conservation aspects (from insect population dynamics and ecological studies); (3) crop protection; and (4) human sociology (from insect sociobiology studies). Without the underlying foundation of knowledge obtained from research on *relatively simple* organisms (terrestrial arthropods, for example), it would be most difficult, if not impossible, to understand processes of development, population dynamics, evolution, disease and sociological interactions in the considerably complex *Homo sapiens*.

Unrecognized Benefits to Humans

Although a great many terrestrial arthropods have been used for human benefit in the aforementioned ways, the staggering number of arthropod species precludes us from identifying the "usefulness" of each and every one at this time. The mere fact that potential benefits do exist would seem reason enough to protect as many species as possible.

It is in this context that rare and endangered insects have special significance. Through human history, the proven value of species originally thought useless to humans (that is, neither beneficial nor harmful), has been repeatedly demonstrated. Ancestors of today's most important crop plants would generally be described as nondescript weeds. Yet, the manipulation of certain genes in these plants, governing traits such as fruit size, sugar content, growth rate, etc., has allowed for increasingly efficient production of food and fiber, thus substantially improving living standards of many humans.

The discovery of valuable traits in rare and little-noticed species is an on-going phenomenon. Some examples follow of both plants and animals having recognized but as-yet-unexploited benefits to humans:

Desert Pupfish: Sometimes the value of an organism goes unappreciated until it has nearly disappeared. Certain pupfish species are prime examples. Even today, individuals protesting federal government domination of land management in the western United States have cited on-going efforts to protect endemic pupfishes as evidence of wasteful government spending. Residents of the Owens Valley (California), however, have noticed that mosquito outbreaks were not as frequent in earlier years when the endemic Owens Pupfish (*Cyprinodon radiosus*) was more abundant in valley swamps and ditches (Kerbavaz, 1980). Mosquito abatement officials are investigating ways in which these fish can be utilized in a biological control program for mosquitoes.

Hawaiian Wild Broad-Bean: This Endangered[3] species (*Vicia menziesii*), pictured on a 1978 United States commemorative postage stamp, occurs only on the island of Hawaii and at one small site. It is thought to possess L-dopa, a drug used in the treatment of Parkinson's disease (Office of Endangered Species, 1978a).

Yellow Meadowfoam: This plant (*Limnanthes douglasii* ssp. *sulphurea* C. T. Mason) was recently proposed for federal protection (Lamberton, 1980). It occurs only on the Point Reyes Peninsula of California. Like other members of the genus, it contains potentially useful seed-oils (Office of Endangered Species, 1981).

Spiderwort: Stamen hairs on members of the genus *Tradescantia* have been found to change colors from blue to pink in the presence of low-level radiation (Grossman, 1979). Such a finding may result in this perennial herb becoming a sensitive environmental monitor of low-level radiation seeping into the environment from nearby nuclear power plants.

Jojoba: This desert-inhabiting plant (*Simmondssia chinensis* (Link) C. Schneid) of the southwestern United States and adjacent Mexico, was found to possess seed oil of superior quality in 1936 (Schneider, 1977). This thermally stable oil has many applications in industry and is currently obtained in great part from the spermaceti organ of the Endangered Sperm Whale (*Physeter catodon*). Agronomists in California and Arizona have been investigating the feasibility of growing Jojoba on a commercial scale (with promising results) (MacLeod, 1977; Yermanos, 1979). Not only would this reduce hunting pressure on Sperm Whales, it could create a valuable source of income for impoverished native American Indians living in arid habitats where Jojoba would grow best.

Bay Checkerspot Butterfly: Recently proposed for Endangered status (Bentzien, 1981), *Euphydryas editha bayensis* Sternitzky (Fig. 1) has been a subject of long-term population studies by Paul R. Ehrlich and colleagues (Ehrlich,*et. al.*, 1975). This work has significantly impacted biological theory in several

[3]The United States government has two categories of protection under the Endangered Species Act of 1973. An Endangered species is defined as a species, subspecies (or distinct population for vertebrates only) which is "in danger of extinction throughout all or a significant portion of its range"; a Threatened species is one "which is likely to become an Endangered species within the foreseeable future throughout all or a significant portion of its range."

Figure 1: The Bay Checkerspot (*Euphydryas editha bayensis*), a recently proposed Endangered species candidate, has played an important role in research on long-term changes occurring within populations.

respects. Few studies on insects have explored in such detail the ways in which population sizes are altered by climatic factors, predators, and/or parasites. More importantly,tudyof genetic frequencies in different populations of *Euphydryas editha* (Boisduval) (including subspecies *bayensis*) yielded remarkably similar gene frequencies in populations separated by considerable distances. Since population movement studies showed that individual checkerspot butterflies moved very short distances during their lifetimes, the lack of variability in gene frequencies could *not* be attributed to the frequent intermixing (and interbreeding) of individuals from different populations. Instead, it appears that natural selection (different rates of reproduction for different gene types), brought about by environmental factors of many kinds, was acting similarly on different populations (McKechnie, *et. al.*, 1975). Yet, at the same time, Ehrlich's group noted wing pattern differences between individuals from the *same* population—where significant gene flow was present. All this has important implications for species evolution theory. The classic viewpoint held that species evolved when geographic barriers prevented what was assumed to be frequent interbreeding (hence, high gene flow) between populations. Once separated by a barrier, the absence of gene flow would supposedly lead to the divergence of structural, ecological and behavioral characteristics of individual organisms of separated populations. Eventually, the separated populations could be considered representative of two distinct species. Yet, the checkerspot butterfly studies, supported by others on plants, indicates that gene flow between populations not separated by geographic barriers is still infrequent and hence, not important in preventing divergence of populations (Ehrlich & Raven, 1969). Also, in the absence of gene flow between populations—over hundreds or thousands of generations—the divergence of characteristics did not necessarily occur as classic theory would predict. Thus, selection appears more important than gene flow in determining the type and extent of differentiation both between and within populations. These results, obtained from a little-noticed butterfly, point out the inadequacy of the commonly held biological species definition: a group of actually or potentially interbreeding natural populations which are reproductively isolated from other such groups (Mayr, 1963). Although work on the Bay Checkerspot continues, the elimination of most of its populations through habitat destruction has seriously limited the possibilities of future comparative studies.

Taiwan pierid butterfly: A small yellow butterfly (*Catopsilia crocale* Cr.) has been found to contain a substance in its wings which has significant anti-tumor effects when applied to laboratory animals (Brewer, 1976). If found effective on humans, the substance could become an important component of chemotherapy treatment for cancer.

Natural Versus Human-Induced Extinctions

The importance of protecting the world's existing gene pool should now be abundantly clear. The majority of the earth's genetic diversity is contained within the Insecta; therefore, it seems logical to devote a substantial portion of available resources towards conservation of this very important group of organisms. Yet, extinction has always occurred and is a natural phenomenon. Why should we try to prevent it? The answer is simple: The current rate of human-induced extinctions far exceed the estimated natural extinction rate. While natural extinctions over time were generally balanced by new species evolution, the current rate of evolution remains, at best, constant. Contrastingly, the extinction rate has become 5 to 50 times as high in the last three centuries, as it was before the Malthusian increase in human population (Ehrlich & Ehrlich, 1979). The result has been a net decrease in species diversity, with all its negative implications. For a convincing treatment of the reasons for saving disappearing species, consult Paul and Anne Ehrlichs' editorial (1979).

Recent Developments in Terrestrial Arthropod Conservation

Geographic Involvement

The geographic bias portrayed at the 1976 symposium was only partly due to actual domination of the field by American and British workers. Terrestrial arthropod conservationists, even then, were active in other nations, notably Europe (Pyle, 1981a), but with scattered representation also in South America (Gerardo Lamas-Mueller, Keith Brown, Jr., and others) and even Africa. Conservation involvement in the Soviet Union was not well known until Robert Pyle brought back news of significant interest and progress in that nation (Ibid). And attendees of the Sixteenth International Congress of Entomology at Kyoto, Japan (1980) returned with heartening stories of a citizenry familiar with, most appreciate of, and willing to protect their insect fauna (Peter Dwelle, Gottfried Wiedenmann, Robert Pemberton; personal communication). Thus terrestrial arthropod conservation efforts up to 1976 were more widespread than then thought.

Of continuing concern, however, is the general lack of interest exhibited in Third World nations. In many such countries, both governmental development programs and expatriate exploitation have brought extensive destruction of natural habitat (Meyers, 1979 paper presented at Association for Tropical Biology Symposium, Venezuela). Unfortunately, many underdeveloped nations occupy tropical or island regions of high endemism and/or species diversity. Indeed, the Malaysian Peninsula has been said to possess perhaps the greatest species diversity of any similar-sized region on earth; yet, Meyers (Ibid) reports on government plans to log the entire peninsula by 1985 or 1990.

On a brighter side, Brown and colleagues (Brown & Ab'Saber, 1979) have employed heliconian butterflies to pinpoint regions of high endemism in South America. The Brazilian government is using such information in determing location of its national

parks (Lovejoy, 1979 paper presented at Association for Tropical Biology Symposium, Venezuela). Butterflies are also being used in a massive World Wildlife Fund Program to assess changing species diversity in Brazilian habitat preserves, now being isolated by surrounding habitat destruction (Richard Bierregard, personal communication). Still, insects have unutilized potential as environmental indicators in the tropics.

Exploration and Monitoring: Extinctions, Rediscoveries, New Populations

Since 1976, more information is being published regarding extinctions and declines of terrestrial arthropod populations. Yet, most of such work still concerns European or American species. This unfortunately detracts from the higher extinction rates and widespread declines occurring in lesser known tropical organism groups. Until additional research (including collecting for scientific purposes) results in a better known tropical arthropod fauna, headlines in terrestrial arthropod conservation will continue to be dominated by temperate fauna species and issues.

In the United States and Great Britain, at least two recent butterfly extinctions have been recorded:

The Lotis Blue (*Lycaeides argyrognomon lotis* (Linter)) of California, designated as Endangered in 1977, was last seen by Richard Arnold in 1978 (Arnold, personal communication). It is now generally thought extinct, its disappearance coinciding with a severe drought. In Great Britain, the Large Blue (*Maculinea arion*), treated by Jeremy Thomas in this proceedings, lost its last British foothold in 1979 (Howarth, 1979), despite a valiant effort by Thomas and others to save it A reintroduction from mainland Europe has been contemplated, but additional life history and autecological research must first be completed. Initial survey of European mainland populations, however, has revealed that their status is not as healthy as previously thought (Robert Pyle, personal communication).

Another United States butterfly protected by the federal government has also apparently disappeared from that country, although some lepidopterists suspect the species was never a permanent resident. This butterfly, the Bahaman Swallowtail (*Papilio andraemon bonhotei* Sharpe) still flies on the larger islands of the Bahamas (Emmel, 1975), but no evidence of breeding in the United States has been recorded for several years.

In the past five years, a number of insects thought extinct have been rediscovered. Also, new populations of other rare or Endangered species have been located. All this, however, is basically due to more intensive exploration leading to more accurate population status assessments, and not to any actual population recovery or increase. In California alone, rediscoveries have included the Delta Green Ground Beetle (*Elaphrus viridis* Horn) (Fig. 2), lost since the 1870's (David Kavanaugh, personal communication); Catalina Orange-Tip Butterfly (*Anthocharis cethura catalina* Meadows) (Orsak, 1976); Coastal Arrowhead Blue Butterfly (*Glaucopsyche piasus sagittigera* (Felder & Felder)) (Charles Sekerman, personal communication); Comstock's Blue Butterfly (*Euphilotes battoides comstocki* (Shields)), lost since 1918 (C. Sekerman, James Brock, Larry Orsak; and others; unpublished data); Kern Primrose Sphinx Moth (*Euproserpinus euterpe* Hy. Edwards), lost for 90 years (Paul Tuskes, Chris Henne, and others; personal communication and unpublished data); and a San Francisco area damselfly (*Ischnura gemina* (Kennedy)) (Garrison & Hafernik, 1979 grant proposal to Xerces Society). Other significant rediscoveries in the United States have included the sphinx moth *Euproserpinus wiesti* Sperry (Karolis Bagdonas, personal communication), the known populations now possibly eliminated by pesticide applications for local grasshopper infestations, and the famous Atala Butterfly (*Eumaeus atala florida* (Poey)) (David Baggett, Thomas Emmel and others; unpublished data and personal communication). It should be noted that detailed descriptions of many of these rediscoveries have remained unpublished due to problems with unscrupulous collectors who have interfered with research or potentially negatively impacted rediscovered populations through indiscriminate collecting for private collections or profit. Some lepidopterists (notably Gall & Sperling, 1980), however, have chosen not to let these problems interfere with the preferred publication and sharing of new information.

New population discoveries of protected and potentially Threatened or Endangered insect species have also occurred. These have included range extensions and new colonies of the Endangered San Bruno Elfin Butterfly (*Callophrys mossii bayensis* Brown) (Arnold, 1978; Orsak, unpublished); San Francisco Tree Lupine Moth (*Grapholitha edwardsiana* (Kft.)) (Arnold, 1980; Jerry Powell, unpublished); and Endangered Smith's Blue Butterfly (*Euphilotes enoptes smithi* (Mattoni)) (range extension: Orsak, unpublished).

New Threatened or Endangered Terrestrial Arthropods

Some insects now being discovered and described are simultaneously being found to be nearing extinction. Two newly discovered United States butterflies are either protected or

Figure 2: The Delta Green Ground Beetle (*Elaphrus viridis*), a recently rediscovered species, is now listed as Threatened by the United States Fish and Wildlife Service.

ORDER ISOPODA	
Exosphaeroma thermophilum	SOCORRO ISOPOD
ORDER AMPHIPODA	
·*Spelaeorchestia koloana*	KAUAI CAVE AMPHIPOD
ORDER ARACHNIDA	
Adelcocosa anops	KAUAI CAVE WOLF SPIDER
ORDER COLEOPTERA	
Agonum belleri	BELLER'S GROUND BEETLE
Anthicus sacramento	SACRAMENTO ANTHICID BEETLE
Cicindela columbica	COLUMBIA RIVER TIGER BEETLE
Coelus globosus	GLOBOSE DUNE BEETLE
Coelus gracilis	SAN JOAQUIN DUNE BEETLE
Coenonycha clementia	SAN CLEMENTE ISLAND COENONYCHA BEETLE
Crossidius mojavensis mojavensis	MOJAVE RABBITBRUSH LONGHORN BEETLE
Desmocerus californius dimophus	CALIFORNIA VALLEY ELDERBERRY BEETLE
Elaphrus viridis	DELTA GREEN GROUND BEETLE
Phobetus robinsoni	ROBINSON'S RAIN SCARAB
Pseudocotalpa andrewsi	ANDREW'S DUNE SCARAB
Pseudocotalpa giulianii	GIULIANI'S DUNE SCARAB
ORDER DIPTERA	
Cophura hurdi	ANTIOCH ROBBER FLY
Raphiomydas trochilus	VALLEY MYDAS FLY
ORDER HEMIPTERA	
Saldula usingeri	WILBER SPRINGS SHORE BUG
ORDER HYMENOPTERA	
Leptochilus arenicolus	ANTIOCH VESPID WASP
Myrmosa pacifica	ANTIOCH TIPHIID WASP
Philanthus nasalis	ANTIOCH SPHECID WASP
Perdita scitula antiochensis	ANTIOCH ANDRENID BEE
Perdita hiticeps luteocincta	YELLOW-BANDED ANDRENID BEE
ORDER LEPIDOPTERA	
Boloria acrocnema	UNCOMPAHGRE FRITILLARY
Euphydryas editha bayensis	BAY CHECKERSPOT
Euproserpinus euterpe	KERN PRIMROSE SPHINX MOTH
Glaucopsyche lygdamus palosverdesensis	PALOS VERDES BLUE
Grapholitha edwardsiana	SAN FRANCISCO TREE LUPINE MOTH
Hesperia dacotae	DAKOTA SKIPPER
Hesperia pawnee montana	PAWNEE MONTANE SKIPPER
Lycaeides melissa samuelis	KARNER BLUE
Speyeria callippe callippe	SAN FRANCISCO SILVERSPOT
Speyeria nokomis nigrocaerulea	BLUE-BLACK SILVERSPOT
Speyeria nokomis nokomis	GREAT BASIN SILVERSPOT
Speyeria zerene hippolyta	OREGON SILVERSPOT
ORDER ORTHOPTERA	
Idiostatus middlekauffi	MIDDLEKAUFF'S SHIELD-BACKED KATYDID

Figure 3: Terrestrial arthropod species candidates for Endangered species listing by the United States Fish and Wildlife Service since 1975. This supplements Opler's figures in this proceedings. Species later withdrawn from consideration indicated by "W"; Species later designated as Threatened (T) or Endangered (E) are idenfified by an asterisk (*).

proposed for Endangered listing. These are the Palos Verdes Blue (*Glaucopsyche lygdamus palosverdesensis* Perkins & Emmel) (Perkins & Emmel, 1977) and Uncompahgre Fritillary (*Boloria acrocnema* Gall & Sperling) (Gall & Sperling, 1980), each currently known from only one population. Still another butterfly, the Bay Checkerspot, has recently (Murphy & Ehrlich, 1980) been restricted to refer only to serpentine-inhabiting populations of the San Francisco, California, region; non-serpentine populations, formerly *E. e. bayensis*, have been designated a new subspecies, LuEsther's Checkerspot (*E. e. luesterae* Murphy & Ehrlich). Subsequently, the Bay Checkerspot has been proposed for federal protection (Hester, 1981).

Certain individuals have spoken out against these recent taxonomic descriptions, charging that the above butterflies were described solely for conservation purposes (only insect populations of subspecies or species rank can be afforded federal protection in the United States), with no regard for taxonomic validity. Yet, an examination of these descriptions

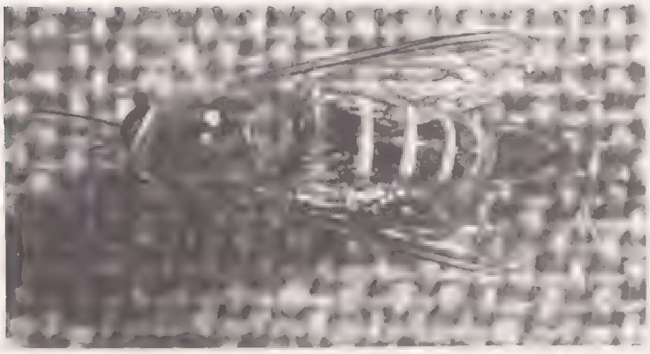

Figure 4: The Kern Primrose Sphinx Moth (*Euproserpinus euterpe*) was the first United States moth to gain federal protection.

Figure 5: The Valley Mydas Fly (*Raphiomydas trochilus*) is one of nine Antioch Dunes (California) insects being considered for possible Endangered or Threatened listing by the United States Fish and Wildlife Service.

show treatment of both morphological and biological characteristics of the new taxa in much greater depth than has been accorded many non-endangered entities.

Since Opler's early 1978 survey of United States government protection of terrestrial arthropods (Opler, 1981), five insects and one fresh water crustacean have been designated Threatened or Endangered by the United States Fish and Wildlife Service. An additional 33 terrestrial arthropods have been proposed for federal protection, of which 17 were later withdrawn from consideration (Fig. 3). Congressional amendments in 1978 to the Endangered Species Act have made it considerably more difficult to list a species. Also, the added paperwork has often made it impossible to designate a deserving species as Threatened or Endangered before the official withdrawal required two years after the initial proposal. It is encouraging to note that the "butterflies from California" bias formerly so evident for United States protected species is no longer as strong. Still, only four of the 14 protected terrestrial arthropods inhabit areas outside California, and ten are butterflies. Protected species now include not only butterflies, but crustaceans, moths (Fig. 4) and beetles; proposed species include a shore bug known only from one hot springs (Cook, 1979); also a katydid, two flies (Fig. 5) and five bee or wasp species (Bentzien, 1980).

Conservation of Declining Species: Habitat Protection

While an important step in conserving any disappearing organism is its recognition and legal protection as a disappearing species, the recent loss of California's Lotis Blue Butterfly indicates the need for more active protection. Since the decline of most terrestrial arthropods has been attributed to destruction or alteration of their natural habitats, habitat protection is a necessity. Significant habitat preserves/reserves have been set aside specifically for terrestrial arthropods since the "Endangered Insects of the World" symposium. Sone accomplishments in both the United States and Papua New Guinea:

Of the original six United States butterflies listed in 1976 as Endangered by the United States Fish and Wildlife Service, additional habitat protection has occurred for four, is probably imminent for the fifth, and may be too late for the presumed-extinct Lotis Blue. Some additional habitat protection has also come about for federally non-protected butterflies such as the Karner Blue (*Lycaeides melissa samuelis* Nabokov); and of course, other terrestrial arthropod populations have gained protection through habitat set aside for other species.

Lange's Metalmark: The most outstanding habitat protection accomplishment for a United States terrestrial arthropod has been the 1980 acquistion of remnants of the Antioch Dunes (Fig. 6), a tiny island-like sandy habitat located in Contra Costa County, California. This 23-hectare parcel, costing US $2.1 million, contains a rich endemic flora and insect fauna (Powell, 1981). Only one of the rare/endemic insects, Lange's Metalmark Butterfly (*Apodemia mormo langei* Comstock) currently receives federal protection, but nine additional insects have been proposed for listing (Bentzien, 1980a). Unfortunately, the transfer to public ownership initially resulted in brief but heavy off-road vehicle activity, the potential disasterous results of which are detailed by Jerry Powell (Ibid). Protests by environmentalists and conservation organizations had their desired effect—the land is currently patrolled and sign-posted. Unfortunately, habitat destruction of the last two years was so extensive that the 1980 Metalmark census (R. Arnold, unpublished) had suffered nearly a 50 percent drop compared to 1977 (Office of Endangered Species, 1980a).

San Bruno Elfin and Mission Blue Butterflies: Status of both the Endangered Mission Blue (*Icaricia icarioides missionensis* (Hovanitz)) and San Bruno Elfin (*Callophrys mossii bayensis* Brown) butterflies (Fig. 7) considerably improved in 1978, following creation of a new 690-hectare regional park, centered on the main ridge of San Bruno Mountain (California) (Fig. 8). The park is intended for light recreational use, such as hiking, and the Committee to Save San Bruno Mountain has kept close watch on it and surrounding San Bruno Mountain lands. Currently, they are pressuring park officials to halt motorcycle trespasses and begin eliminating the invasive, introduced European Gorse (*Ulex europaeus* L.) plants, both of which threaten the natural habitat and its dependent Endangered butterflies. Unfortunately, the largest populations of the Mission

Figure 6: A portion of the Antioch Dunes remnant purchased by the United States Fish and Wildlife Service in 1980.

Figure 7: Status of both the Endangered Mission Blue (*Icaricia icarioides missionensis*) (left) and San Bruno Elfin (*Callophrys mossii bayensis*) butterflies have improved since part of their known habitat was included in a recently dedicated county regional park.

Figure 8: A ridgeline park on San Bruno Mountain protects populations of several rare organisms, including two Endangered butterflies. Yet, large populations of the Endangered Mission Blue (*Icaricia icarioides missionensis*) and proposed-Endangered San Francisco Silverspot (*Speyeria callippe callippe*) remain threatened by a proposed housing development on the northeast ridge (arrow) and south-facing slopes of the Mountain.

Blue Butterfly lie just outside of park boundaries (Arnold, 1978, 1980), generally on sites tentatively planned for housing developments.

Like the Antioch Dunes, San Bruno Mountain is home for more than one or two Endangered species. Within park boundaries grow four Manzanita (*Arctostaphylos*) species, two of which are endemic; two potentially endangered crucifers; an endemic bee (*Duforea stagei* Bohart); and other scarce plants and animals (Anonymous, 1980; Arnold, 1980; McClintock, unpublished report; McClintock & Knight, 1968).

Smith's Blue Butterfly: From recent autecological and survey research by Richard Arnold (1978), the finding of new populations, with a slight range extension by others (Orsak and Westdal, unpublished) and the inclusion of several populations within preserves/reserves, it can be concluded that Smith's Blue (*Euphilotes enoptes smithi* (Mattoni)) is currently non-Endangered from a realistic, if not official viewpoint. The butterfly occurs in innumerable, often inaccessible sites in Monterey County (California). Populations are protected at Fort Ord Military Reservation (Opler, 1981); on state beach land near Partington Point (Orsak, personal observation); a Califonia Department of Fish and Game Ecological Reserve, Point Lobos State Reserve and "a new reserve near Lucia" (Arnold, Ibid), the latter of which may refer to colonies within the "Landels-Hill Big Creek" reserve of the University of California (Orsak, personal observation). The physical inaccessibility of many populations also offers some protection from habitat alteration, although sand dune-inhabiting populations are far more vulnerable than those of rocky coastal bluffs.

El Segundo Blue: The amount of land to be set aside for the Endangered El Segundo Blue Butterfly (*Euphilotes battoides allyni* (Shields)) and its dune coinhabitants is still being determined. Although a 0.8-hectare reserve was set up by Standard Oil Company of California (Oppewall, 1978; Anonymous, 1978), that protected colony is far exceeded both in size and areal coverage by the other surviving population located on nearby Los Angeles International Airport land. Airport Commissioners favor a 16-hectare preserve, but the Endangered butterfly occurs outside these boundaries (Arnold, Ibid); biologists familiar with the dune wildlife urge protection of an additional 104-hectare site. Xerces Society member Julian Donahue spearheads current political efforts to gain protection of this entire but paltry remnant of the El Segundo Sand Dunes habitat.

Preserves for Threatened Butterflies: New habitat preserves may be created for two United States insects, listed as Threatened. A proposed acquisition of crocodile habitat in Florida by the United States Fish and Wildlife Service would protect Schaus Swallowtail (*Papilio aristodemus ponceanus* Schaus) populations (Charles V. Covell, Jr., personal communication). And the United States Forest Service is taking the Oregon Silverspot (*Speyeria zerene hippolyta* (Edwards)) into account in its land use plans for Suislaw National Forest (Robert Pyle, personal communication).

Birdwing Butterfly Preserves: Although United States endangered butterfly habitat has been reasonably successful, perhaps greater achievement can be identified in underdeveloped Papua New Guinea. The largest butterfly in the world, Queen Alexandra's Birdwing (*Ornithoptera alexandrae* Rothschild), exceedingly restricted in distribution and numbers, is threatened by habitat destruction from oil palm plantations

and clear-cutting (Pyle & Hughes, 1978). The national government, aware of the importance of its Birdwing Butterfly national resources, has set aside wildlife management areas for all seven protected Birdwing Butterfly species.

Research and Habitat Management

The importance of research in endangered species protection cannot be overemphasized. Prior to the "Endangered Insects of the World" symposium, little research had been initiated specifically for rare/endangered insect enhancement or protection in the United States, with some exceptions (Covell & Rawson, 1973; Dirig & Cryan, 1977; Orsak, 1977; Rawson, 1961; Robert Wind, 1973 letter to Robert Dirig). This contrasted with the British situation, where different projects had focused on the Large Copper (*Lycaena dispar batavus* Obth.) (Duffey, 1968, 1977); Black Hairstreak (*Strymonidia pruni* (L.)) (Thomas, 1974, 1981); Large Blue (*Maculinea arion* (L.)) (Howarth, 1973; Thomas, 1981); and British Swallowtail (*Papilio machaon britannicus* L.) (Dempster, *et. al.*, 1976; Dempster & Hall, 1980; Thomas, Ibid) butterflies.

Pure and applied research are both important in saving declining arthropods. Pure research includes observational studies: life history, autecological, survey and behavioral. Applied work entails habitat manipulation and introduction attempts. While British scientists have conducted both types of research on their declining butterflies, work in the United States has primarily focused on survey and life history work (Andrews, Hardy & Giuliani, 1979; Arnold, 1978, 1980; Cryan & Dirig, 1976, 1978; Hardy & Andrews, 1976, 1979); more applied work is emerging, however (Arnold, unpublished; Robert Dana, 1978 & 1979 grant proposals to Xerces Society; Francis Howarth, 1979 grant proposal to Xerces Society; Office of Endangered Species, 1979; Thomas Reid Associates, 1980; Rittner, 1976a; Slobodchikoff & Doyen, 1977).

With the exception of Europe, and perhaps Japan and the Soviet Union, terrestrial arthropod conservation research remains in its infancy. A notable recent exception is far-sighted Papua New Guinea, where a research program entailing both pure and applied aspects, is supported by the national government (Pyle & Hughes, 1978; Vietmeyer, 1979). The purpose of this work is to help develop a successful Birdwing Butterfly farming industry, the profits of which will benefit citizens of that country.

A combined lack of interest and money contributes to the inadequate amount of data available for endangered terrestrial arthropods. In the United States, the Xerces Society has sought a partial solution to the problem through its grants-in-aid program, funding 17 separate projects since 1974, 15 of these since the 1976 symposium. Although most proposals have dealt with butterflies and all have received maximum funding of several hundred dollars, the program occupies a niche not filled by budget-strained state and federal endangered species programs.

Legal Protection

The lack of adequate laws truly protecting declining terrestrial arthropods remains nearly as great a problem today as five years ago. The United States Endangered Species Act of 1973, described by Schreiner (1981) and praised by Opler (1981) as the world's toughest endangered species law, has since been signficantly weakened by the United States Congress, through a series of 1978 amendments (Office of Endangered Species, 1978b, 1980b, c). At least three changes in the law were particularly relevant to future terrestrial arthropod protection efforts: (1) Distinct populations of invertebrates below the subspecific level can no longer gain federal protection; (2) In conflicts between development and endangered species protection, the law now permits a way in which development might procede, regardless of its negative impact on the organism; and (3) the added paperwork created by the 1978 amendments has seriously hampered the labor-short Fish and Wildlife Service from listing all species which merit protection. The outlook for the entire United States federal endangered species program offers no promising developments; substantial budget cuts have been predicted for the next several fiscal years under the present administration.

In countries other than the United States, recent legislation has offered little new protection for endangered arthropods. In Australia and Mexico, for example, insect collecting without a permit is forbidden (applies only to expatriate collectors in Mexico). Other nations, including he United States, automatically prohibit collection of designated endangered species, even when collecting is not a detrimental factor. Indeed, while such laws might ideally protect vertebrate populations from further decline, the reproductive capabilities exhibited by most *in*vertebrates preclude overcollecting as a detrimental factor, except in rare cases, usually involving species already decimated by other means. This is particularly evident in Taiwan, where an estimated ten million butterflies are killed annually for art work and decoration (Severinghaus, 1977), with little or no observable negative effects on populations. Even in the United States, a butterfly collector could conceivably be prosecuted for collecting a single Smith's Blue Butterfly, while a private landowner could bulldoze that butterfly's habitat without legal reprisal.

Clearly, most governments do not wish to take on the real responsibilities involved in protecting endangered invertebrates, but use collecting as a convenient scapegoat. Fortunately, the Xerces Society has recognized the value of collecting for educational and scientific purposes—both of which have positive benefits for heightened public awareness and species conservation. The Society's advisory code for collecting is stated in its "Policy on Collecting" (Xerces Society, 1978).

Still, present endangered species law is preferable to none, and has brought many positive benefits to declining terrestrial arthropod species, as the following examples illustrate.

Political Controversies Over Butterflies

The impact of terrestrial arthropod conservation efforts can be assessed by noting the extent to which local politicians consider these organisms in policy decisions. This type of impact, since the 1976 symposium, has probably undergone the most radical changes in the United States. At least four heated controversies in that nation have revolved around butterflies. This increased interest usually stemmed from initial protection given these butterflies by state or federal government.

San Francisco Silverspot: A revised Fish and Wildlife Service Critical Habitat proposal (Bentzien, 1980b) for this butterfly (*Speyeria callippe callippe* (Boisduval)) (Fig. 9) triggered almost paranoic response from a landholding company and local politicians, because the Critical Habitat boundaries closely (but independently) duplicated those of a proposed US $300

Figure 9: The San Francisco Silverspot (*Speyeria callippe callippe*), subject of perhaps the largest scale mark-release-recapture program ever conducted on an insect. The findings will be used to determine if and how a proposed housing development could be planned to minimally affect the butterfly.

million, 2200-home development. The reaction occurred despite the fact that Critical Habitat designation in no way is equivalent to a habitat preserve; it merely serves as a warning flag to federal agencies contemplating activities in the area, such as construction of roads or dams. The problem was accentuated by a severe local housing shortage combined with suspicions that the butterfly had been proposed for Endangered listing merely to stymy development. The heated debate (detailed in Orsak, 1980) lasted about a month. The landholding company finally agreed to fund a large-scale study on the Silverspot, the coinhabiting Endangered Mission Blue Butterfly and other plant and animal species of concern. The Phase One study (Thomas Reid Associates, 1980) included what is probably the largest mark-release-recapture program ever attempted for an insect. Phase Two research covers more specifically, hostplant distributions, surveys of other sensitive plant and animal species, and a focus on habitat manipulation schemes that might allow the coexistence of the sensitive species and some housing. Despite the subsequent withdrawal of the Silverspot butterfly from Endangered species consideration (blamed by local environmentalists on political pressure and payoffs, but officially attributed to a lack of sufficient data), the biological study will continue as though the butterfly were already protected.

Karner Blue Butterfly: On the other side of the continent, this New York State-protected species has figured prominently in efforts to preserve the unique pine barrens of the Albany, New York area (known as the Pine Bush) (Rittner, 1976b, c). Habitat protection efforts have been initiated primarily by the local Pine Bush Historic Preservation Project. Unlike the San Francisco Silverspot controversy, Karner Blue-development conflicts have surfaced repeatedly, whenever new portions of the Pine Bush have been proposed for destruction (Dirig & Cryan, 1977; Orsak, 1979a). Analagous to the Silverspot debate, Xerces Society members found themselves on opposing sides regarding the amount of development they felt could be tolerated by the butterfly.

During the past two years, a shopping mall developer has funded a major Karner Blue study for a population located on the shopping center site. This colony site is going to remain undeveloped, albeit mostly surrounded by a parking lot (Dale Schweitzer, paper presented at 1980 annual Xerces Society meeting, Laramie, Wyoming; Lawrence Gall and Don Rittner, personal communications). This research program has included a butterfly mark-release-recapture project (Gall, 1979) which, while not approaching the scale of the Silverspot effort, is arguably the most intensive and thorough ever conducted on a butterfly. Whether this newly isolated Karner Blue population will survive is debatable; the results, in any case, will be of great relevance to future mitigation involving rare butterflies and proposed developments.

El Segundo Blue Butterfly: Habitat preservation efforts for this Endangered species have already been summarized. The main controversy centers over how much habitat at Los Angeles International Airport warrants protection. While the butterfly does not occur over the entire dune remnant, and much of this open area is severely disturbed, conservationists argue that setting aside the entire contiguous site would eventually result in larger, more stable populations of the El Segundo Blue and other rare dune-inhabiting organisms (Julian Donahue, personal communication).

Monarch Butterfly: A proposed industrial plant, emitting low levels of pollutants, was planned for a site adjacent to a large and scientifically important overwintering population of the Monarch Butterfly (*Danaus plexippus* (L.)) (Fig. 10) in Santa Cruz (California). This colony happens to occupy state park land and the issue concerned the extent to which pollutants would negatively affect this supposedly protected population. Although the factory was approved, and will probably have negligible negative effect, John Lane (paper presented at 1980 annual Xerces Society meeting, Laramie, Wyoming) foresees more serious problems in the future, derived from the absence of any comprehensive status evaluation of that state's overwintering site in Marin County (Raymond Peterson, personal communication); this probably represents but one of a series of potential threats to affect these unique natural resources.

Figure 10: Overwintering populations of the common Monarch Butterfly (*Danaus plexippus*) merit special conservation consideration in both the United States and Mexico.

Unfortunately, in the above controversies, generally too much emphasis was directed towards single species conservation. This was an inaccurate approach, since the San Bruno Mountains, Pine Bush and El Segundo Dunes all harbor other rare or endemic organisms, often equally endangered and deserving of protection. Perhaps this overemphasis has been intentionally promoted by foes of habitat preservation, since it creates unnaturally simple "butterfly versus people," "butterfly versus housing," even "butterfly versus housing for the handicapped and elderly" (Orsak, paper presented at 1980 annual Xerces Society meeting, Laramie, Wyoming) -type disputes that tend to minimize public sympathy for the plight of an endangered organism.

Individual, Organizational and Public Agency Involvement

Although support on all three levels has for some time occured in Great Britain (Morris, 1981; Moore, 1981) it has barely begun in other nations. In Papua New Guinea, the government now fortunately recognizes the renewable resource potential of that nation's butterflies, if properly managed (Pyle & Hughes, 1978; Vietmeyer, 1979). In Mexico, pressure from Mexican and American scientists has brought some government support and action for protection of immense overwintering sites of the Monarch Butterfly. One result of these efforts, a recently instituted protective law (Urquhart & Urquhart, 1980) will, by itself, do little to actually protect these populations from ongoing threats (Robert Pyle, personal communication). The law nevertheless serves to identify these populations as being important; continued pressure, particularly by Mexican citizens, will hopefully yield direct habitat protection results.

In the United States, individual and organizational involvement in terrestrial arthropod conservation has experienced almost exponential increase in the last five years, but still focuses primarily on butterflies. Individuals and nonconservation citizen groups have lent varying degrees of support to habitat protection efforts for the Karner Blue, El Segundo Blue and Endangered San Bruno Mountain butterflies. The Xerces Society cooperated closely with the California Native Plant Society, National Alliance for Plants and The Nature Conservancy in Antioch Dunes habitat acquisition efforts, and with the Pine Bush Historic Preservation Project in attempting to preserve Karner Blue populations. Although entomological organizations, such as the Entomological Society of America (ESA) and Lepidopterists' Society have remained only peripherally involved in endangered insect conservation, more published information on specific species and issues has appeared in their publications. In regard to the ESA, this was brought about in part by an invitation to the Xerces Society to become an organizational affiliate in 1977; this permitted limited Xerces Society publication of items in ESA publications. A recent survey of the Lepidopterists' Society members indicates fairly wide support for Lepidoptera conservation (Donahue, 1981; Pyle, 1981b). And the Xerces Society involved the Maryland Entomological Society in terrestrial arthropod conservation by inviting that organization to jointly meet with the Xerces Society at its 1979 annual meeting. Finally, and most importantly, the World Wildlife Fund and International Union for the Conservation of Nature and Natural Resources (IUCN) has, since 1976, become involved substantially with declining arthropods, thanks largely to efforts by Robert Pyle, as Chairperson for the Lepidoptera Specialist Group of IUCN. Pyle is currently working on a Red Data Book for IUCN that will identify lepidopteran species of conservation concern and guide future conservation efforts for these organisms. Furthermore, the World Wildlife Fund has made some funding available for endangered/declining arthropod research.

In the United States, a number of public agencies have recently included terrestrial arthropods in land management plans. The Bureau of Land Management has funded studies on the Nokomis Silverspot (*Speyeria nokomis nokomis* (Edwards)) undertaken by Richard Arnold (Scott Ellis, paper presented at 1980 Xerces Society annual meeting, Laramie, Wyoming) and California desert beetles (Andrews, Hardy & Giuliani, 1979; Hardy & Andrews, 1978).

The United States Forest Service has funded status assessments of the Mono Checkerspot (*Euphydryas editha monoensis* Gunder) and Apache Silverspot (*Speyeria nokomis apacheana* (Skinner)) (Murphy, 1979), and has included the Threatened Oregon Silverspot Butterfly in its land use plan. This recent attention by federal agencies to rare and endangered butterflies has in great part been due to implementation of the Endangered Species Act of 1973, which states that each federal agency shall "insure that any action authorized, funded, or carried out by such agency does not jeopardize the continued existence of any endangered or threatened species or result in destruction or adverse modification of habitat of such species...." Unfortunately, exemptions from this requirement are now sometimes possible under amendments to the law passed by the United States Congress in 1978.

Education

In the United States particularly, educational benefits derived from publications and news releases have increased substantially. This has primarily been the result of the Xerces Society and its members. Since 1976, the Society has issued one interest-generating color postcard (Fig. 11), with the printing of two others to take place during 1981. The Society also initiated a new publication series, the *Educational Leaflets*, each of which presents a synposis of a particular species or arthropod conservation issue. These educational materials, combined with the pre-existing *Self-Help Sheet* series, inform and instruct naturalists, conservationists, conservation organizations and other segments of the general public. The Society has also had considerable success with its annual Fourth of July Butterfly Count. This annual census, modelled after the Audubon Society Christmas Count for birds, had been undertaken for the first time just prior to the 1976 symposium; it has since grown steadily in number of yearly participants.

The Society has only recently attempted to exploit the educational benefits which could be derived from the increasingly popular insect zoos. During 1981, a photographic exhibit on San Francisco Bay area Endangered butterflies and their habitats, sponsored by the Xerces Society, will be on display at the San Francisco Insect Zoo. Another area of great educational potential is butterfly gardening. Xerces Society member Jo Brewer has prepared a new *Self-Help Sheet* on this subject, which will be sent to the over 50 individuals requesting information on this subject from the Xerces Society during 1980.

Since 1976, several important meetings or symposia have focused on endangered terrestrial arthropods and their conservation: A 1977 ESA-sponsored symposium "Progress in the Implementation of the Endangered Species Act and the Convention on International Trade in Endangered Species of

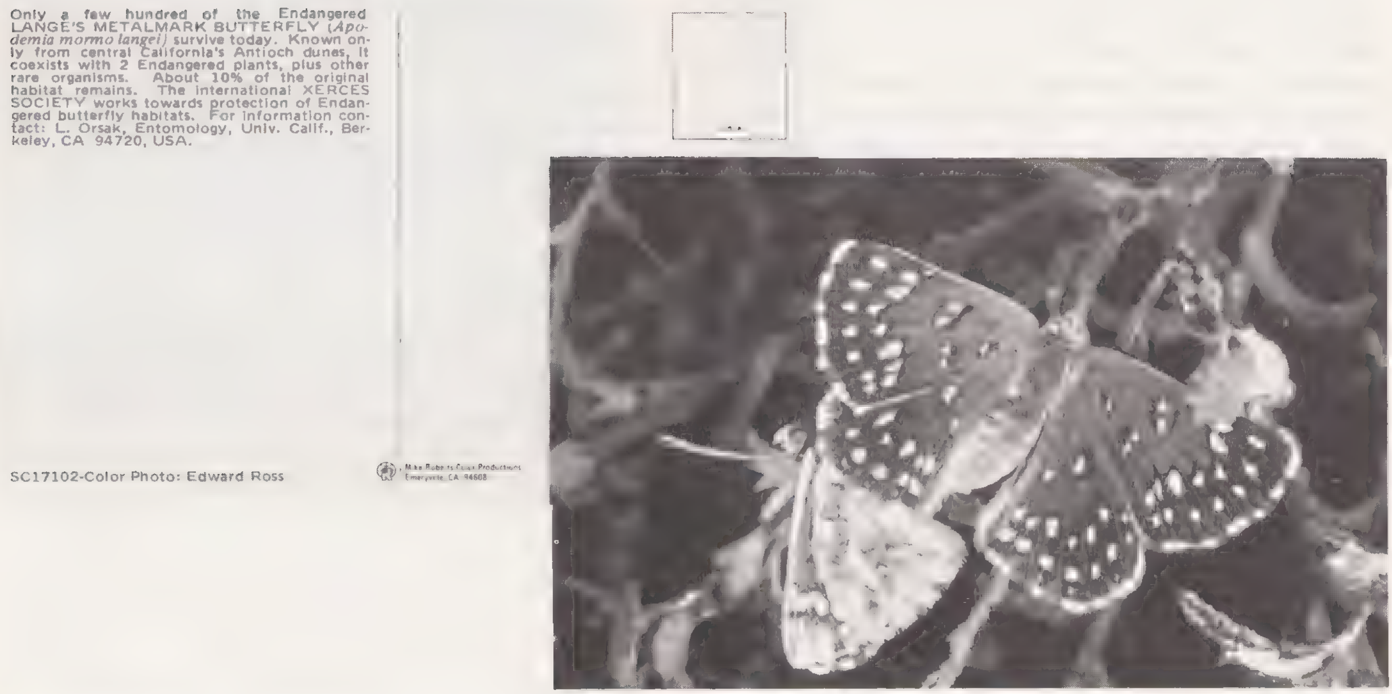

Figure 11: The first postcard to portray a United States federally protected terrestrial arthropod. Such educational tools are important in attracting public attention and support for endangered terrestrial arthropods and protection of their habitat.

Wild Fauna and Flora"; the 1980 Second European Congress of Lepidopterology at Karlsruhe, Germany, which had the theme of "Conservation of Lepidoptera and Their Biotopes"; and a joint Xerces Society-California Native Plant Society symposium in Oakland, California (1978), entitled "Plants and Insects of Two Endangered California Habitats." In addition, the presence of Robert Pyle at the 1978 Fourteenth General Assembly of the IUCN at Ashkhabad, Turkmenia (Soviet Union) (Anonymous, 1979b) and of myself at the Fifth International Symposium of the Association for Tropical Biology at La Guira, Venezuela (Orsak, 1979b), insured that butterfly conservation interests and the Xerces Society would be represented at this important meeting.

Thus, there have been many ways in which increases in terrestrial arthropod conservation awareness have been promoted. It should be noted that even in Great Britain, where rather substantial support already exists for endangered insect conservation (Morris, 1981), the tragic loss of the Large Blue Butterfly had one positive benefit in that it further heightened public awareness concerning the precarious state of some British organisms (Jeremy Thomas, personal communication to Robert Pyle).

Future Trends and Needs

Considerable progress has been achieved in terrestrial arthropod conservation in the almost five years since the "Endangered Insects of the World" symposium. Hopefully, the attention directed to conserving this organismic group will increase, until conservation interest approaches a level equalling the importance of terrestrial arthropods in the natural ecosystems of the world. Until that time, much remains to be done: Insects, even recently, have continued to disappear; in one case, despite substantial effort to save it. Populations continue to be destroyed, including some where active preservation support had been visible. Endangered species programs, such as that of the United States, are under pressure to dissolve or be greatly weakened. And large numbers of individuals continue to question the need for saving *any* terrestrial arthropod. These are the general problems which will dominate the future, and some specific examples, with possible solutions follow:

Public Support: Virtually every aspect of any species conservation movement hinges on the presence of public support. Such support exists for endangered bird and mammal protection but remains minimal for terrestrial arthropods; insect conservationists thus have a considerable task in increasing public support for this group.

Vocal support for an endangered insect is not always a prerequisite for saving that species. A simple lack of negative response may positively impact habitat preservation efforts. A recent illustration of this may have occurred during the controversy involving the San Francisco Silverspot Butterfly of California. Following the reproposed Critical Habitat designation by the Fish and Wildlife Service for that butterfly (Bentzien, 1980b), both the landholding company and local County officials went to the press (Orsak, 1980), trying to appeal to public sympathy, with a probable goal of generating public outrage against protecting the land for endangered butterflies—at the expense of needed housing. When the outrage did not materialize, both the landowners and public officials were placed on the defensive as illustrated by subsequent statements to the media that they never had any intention of eliminating the Silverspot. I am convinced that the failure to stir up dissent against the butterfly was partly due to publicity

efforts by the powerful committee to Save San Bruno Mountain, with help from the Xerces Society, which attempted to diffuse the controversy by publicizing the *possibility* of a compromise between endangered San Bruno Mountain organisms and needed housing. it is also interesting to note that before the issue became so public, repeated warnings concerning the implications of the Endangered Mission Blue Butterfly occurring on this property had been ignored by the landholding company (Arnold, personal communication), even though the presence of that species alone should have caused considerable concern. Indeed, the research program (Thomas Reid Associates, 1980) to study the sensitive organisms of the proposed development site was set up almost two years following the initial Endangered proposal for the Silverspot, over four years following listing of the Mission Blue Butterfly, and over two months following the contested Silverspot Critical Habitat proposal. All this suggests that public response for the butterfly, as generated by local conservation groups—and lack of major public outcry against the butterfly—finally convinced both County and landholding company representatives to take a different approach in dealing with the rare and Endangered San Bruno Mountain organisms.

It should now be apparent as to why public support for (or reluctant acceptance of) terrestrial arthropod conservation is important to acquire. Gaining such support involves several basic steps. First, citizens must recognize the importance of terrestrial arthropods in their own lives, and as constituents of natural ecosystems. Such appreciation can be gained via nature interpretive efforts which acquaint citizens with particular organisms and their hopefully fascinating lives. Except in Japan, and perhaps Great Britain, the general public feeling towards insects leaves much to be desired.

Second, citizens must recognize the importance of protecting endangered species, particularly terrestrial arthropods. The participation of researchers in this educational phase is particularly crucial, for they often have access to convincing evidence of potential and actual benefits that could be derived from certain rare and endangered species. Likewise, they often possess the in-depth life history knowledge invaluable to nature appreciation and interpretive programs. Such information has the potential to generate public support and it is the responsibility of knowledgeable entomologists to disseminate this information.

Getting Away from Single Species Conservation: The negative repercussions of single species conservation have been discussed. Since terrestrial arthropods have generally been included in national endangered species programs relatively recently, every deserving organism has not yet gained protection. Thus, although the Antioch Dunes of California possess a number of rare and endangered insect species, only one is actually protected, although nine others are now proposed for protection (Bentzien, 1980a). Had all ten insects been under federal protection at the time of habitat acquistion efforts, it may have been easier to garner support for protection of the site as a truly unique and endangered ecosystem. Until official endangered species listing can reflect the true status of rare and declining terrestrial arthropods, however, it remains the responsibility of citizen conservationists to promote the concept that one endangered species often indicates the presence of an endangered *ecosystem*, inhabited by other rare organisms. An excellent illustration of this concept is in Opler (1979), which shows the domino effect on other species caused by the decline of one plant, the American Chestnut (*Castanea dentata* (Marsh.)).

Unified Habitat Preservation Efforts: Future controversies involving endangered terrestrial arthropods will probably continue to result in conservationists taking conflicting views; this has occurred in virtually every dispute to-date in the United States. Although it would be ideal for the Xerces Society or other conservation organization to serve as the sole "official voice" for local arthropod conservation issues, there will always be dissenting views to Society policy statements, even within the membership. A proposal to set up an arbitrating review board within the Xerces Society to decide which stance to take in a particular dispute (based upon available biological data) may eventually allow Xerces Society opinion to become more widely respected. Hopefully, this will convince local conservationsts and researchers to join ranks with the Society in presenting a unified front against destruction of unique habitats. It is clear that continued public disputes between researchers, as occurred most visibly during efforts to save Mexican overwintering sites of the Monarch Butterfly, can only reduce the long-term chances for habitat protection.

Unification of the terrestrial arthropod conservation movement in the future will hopefully not occur solely in the context of local issues. Except for the most active workers in the field, there remains a serious lack of communication concerning research and educational efforts occurring in the world. The Xerces Society currently offers the greatest potential to become the international representative for terrestrial arthropod conservation, and could thus serve an important, unduplicated role in the general conservation movement.

The Need for Additional Research: It is absolutely imperative that additional research be undertaken for endangered and declining terrestrial arthropods. A prime example of what should be avoided in the future is illustrated by the Large Blue Butterfly, where detailed autecological work was conducted while the species was perilously close to extinction. It would have been preferable if such studies had been initiated when the Butterfly's decline was first noted almost a century before (Marsden, 1884).

In the United States, research needs to focus more directly on habitat management, in the same way as recent British studies, such as those on the British Swallowtail Butterfly by Dempster and Hall (1980). Unfortunately, an exaggerated concern for a declining organism sometimes inhibits such research by creating overly extensive biological data prerequisites. A personal experience of this nature concerned a proposed *re*introduction of the Pheres Blue Butterfly (*Icaricia icarioides pheres* (Boisduval)) to San Francisco dune remnants from nearby Point Reyes. Initial approval was reversed by the National Park Service due to subsequent guidelines affecting such reintroductions; these new rules required data of the depth which has not been accumulated for any United States butterfly, endangered or otherwise. Yet, introduction attempts, if carefully monitored and carried out by qualified individuals, offer the possibility of providing more than speculative answers to questions concerning whether or not an unutilized habitat would truly satisfy the environmental requirements of an organism should it ever encounter the site (a process considerably quickened by artificial introduction).

Not only should research focus on previously identified declining and endangered arthropods, it should continue to seek those whose status remains uncertain. The sheer numbers of terrestrial arthropod species is such that many are still known only by their scientific name and type locality, with absolutely no information available on range and abundance, much less on

population changes. Thus, general survey still plays an important role in terrestrial arthropod conservation research. Such research should be especially encouraged in tropical regions and habitats of high endemism, since it is in these areas that the greatest ongoing declines of terrestrial arthropod species have been predicted. Survey research could also be considerably encouraged by removing the restrictive permit requirements now in effect for United States National and many State Parks. While park visitors certainly have the right not to see individuals killing wildlife (even for scientific study), present permit requirements often mistakenly assume that (1) insect are easily harmed by overcollecting, (2) scientific contributions can usually be made only by researchers associated with established educational institutions, and (3) once a park's insect fauna has been studied by an investigator, follow-up studies yield no additional useful information.

Strengthening Legal Protection

New laws need to be enacted in many nations to afford protection for terrestrial arthropods for the first time, old laws focusing on overcollecting need to be changed to include habitat preservation, and currently effective law needs to be retained, not weakened. All this represents a particularly challenging need which will be especially difficult to achieve. Organizations such as the Xerces Society must set up effective lobbying programs (probably through more powerful conservation organizations such as IUCN, Audubon Society, National Wildlife Federaion and Sierra Club). In the United States, there is current pressure to further weaken the existing Endangered Species Act of 1973. I think this danger might be averted with the following steps by the Xerces Society:

1. Increased communication between the Xerces Society and the Office of Endangered Species so that congressional progress on and feelings towards endangered species protection can be closely monitored.
2. An increase in articles and press releases by the Society and its individual members to further publicize the importance of insects in terrestrial ecosystems (to counter the more negative press which insects usually receive) and the need for protecting certain species. Such information should reach both mass media publications (such as daily newspapers) and those of large conservation organizations.
3. Increased liaison with other conservation organizations to minimize duplication of effort.
4. Organization of letter writing campaigns by all conservationists to congressional members, in support of a strong endangered species law. Xerces Society members will play an unduplicated role by focusing on endangered terrestrial arthropods, particularly butterflies. Special emphasis needs to be placed on the *benefits* of including terrestrial arthropods in endangered species programs. Presently, widely publicized butterfly-development conflicts probably hurt terrestrial arthropod conservation programs due to the simplistic portrayal of complex issues by reporters. Xerces Society members must emphasize the successful resolution of such conflicts to members of Congress, to counter opposing groups that will certainly publicize the problems and conflicts resulting from federal protection for invertebrate organisms.

Non-Endangered Insects: Those arthropods in danger of total extinction or serious populations decline should not constitute the *only* subjects of terrestrial arthropod conservation efforts. Althogh a few professional lepidopterists have dismissed attempts to save local populations of generally common butterfly species, the loss of any conspicuous, common butterfly from a neighborhood probably has greater negative implications for nature awareness and appreciation than does the total disappearance of many arthropod species (Robert Pyle, paper presented at 1977 Xerces Society annual meeting, New York City). In addition, certain local populations possess scientific value in their own right; notably overwintering Monarch Butterfly populations. And the designation of official National, State or Provincial butterflies and insects, while perhaps not offering any direct protection to a species, nevertheless may increase local awareness of arthropods as a whole; the presence of such designated species may also be a deciding factor in preservation of natural habitats (Pyle, 1979b).

Summary

This, then, is the argument for trying to protect terrestrial arthropods, with an update on those papers presented at the 1976 "Endangered Insects of the World" symposium. The infant state of terrestrial arthropod conservation as an international discipline in 1976 should be evident, also the rapid progress which has since been achieved. I personally am convinced that much progress was stimulated when this first forum for international cooperation took place. In the United States alone, the field has been significantly aided by examining the problems and achievements faced by British workers. Althoug the 1976 meeting was an historic step in information sharing and cooperation, I sincerely hope that benefits accrued from that event will create the impetus for many future gatherings, national and international. A summer 1981 symposium on the Mexican overwintering Monarch Butterfly populations, the proceedings of which are tentatively planned for publication in *Atala*, represents the type of cooperative terrestrial arthropod conservation meeting that I hope will proliferate on conservation and entomological meetings agendas.

Acknowledgements

These proceedings have long been slated for publication. This originally was to be achieved by the United States Fish and Wildlife Service. Publication responsibility was undertaken by the Xerces Society when government publication plans faltered. The submitted manuscripts then languished, much to our chagrin, while the volunteer editorial and leadership staff of the Society focused on pressing insect conservation issues. Thus, I must acknowledge the continued patience of the eleven authors, as well as all Xerces Society members (particularly the Board of Directors) during this time period. Specific gratitude is expressed to Robert Dirig for his initial reviews of the symposium papers, also his continuing expert guidance and editorial advice during this, my first editorial responsibility. Rudolf H. T. Mattoni and his staff saves the project by agreeing to assume Xerces Society typesetting and printing chores; they too, have exercised considerable tolerance at endless delays. Finally, Robert M. Pyle, Douglas W. Whitman, Koichiro J. Yagi, Xerces Society President Karolis Bagdonas and Jan Washburn lent much help in the preparation of the proceedings and this manuscript.

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Introductory Remarks

John Heath

Institute of Terrestrial Ecology, Monks Wood Experimental Station, Abbots Ripton, Huntingdon, PE 17 2LS, GREAT BRITAIN

Abstract

In addressing the topic of endangered insects, it is necessary to consider the following questions: What is an endangered insect? How do we know that it truly is endangered? Why should we consider protecting an endangered insect species? Finally, how should we be going about insuring its long-term survival?

Introduction

This is the first time in the history of the International Congress of Entomology that there has been an entire symposium devoted to a wildlife conservation topic. In the opening address, T. R. E. Southwood, in exploring the many facets of entomology, included the conservation of butterflies.

When considering endangered insects, several questions need to be answered. First, what is an endangered insect? Is it a species such as *Parnassius apollo* L., some sub-species of which may suffer from overcollecting in Europe? Is it a species such as *Maculinea arion* L., which in the United Kingdom is on the edge of its range and confined to a single small locality? Is it a species such as *Speyeria nokomis* (Edwards) (Fig. 1), a North American wetland species with a threatened habitat? Is it a *Morpho* species from South America which is used in the manufacture of jewelery? Is it a species such as *Ectoedemia turbidella* (Zeller), which in the United Kingdom is confined to overmature trees in only a few localities?

Second, how do we know that a species is likely to be endangered? In general, such knowledge comes about in one of two ways: Either reports (often verbal and highly subjective) are made by entomologists and others; or, national surveys (such as those pioneered by the Biological Records Centre of the Institute of Terrestrial Ecology, Monks Wood Experimental Station, Huntingdon, in Great Britain) are undertaken. The latter survey is now being carried out throughout Europe and is coordinated by the European Invertebrate Survey.

Third, why should we be concerned that an insect species may be endangered? For ethical reasons? For aesthetic reasons (are butterflies, for example, desirable components of the countryside)? Or for ecological reasons?

Finally, if we are concerned, what can we do about it? Should we investigate the status of the species concerned? Should we educate the public to appreciate the need for conservation? Should we allocate land for nature reserves to protect insects? And should we legislate to enforce the protection of insect species?

Figure 1: The Silverspot Butterfly *Speyeria nokomis* usually inhabits wet areas surrounded by much drier surroundings from Colorado west to California, south to Chihuahua, Mexico, and north to Utah. Its restricted habitat in a water-starved region makes it susceptible to even small-scale habitat changes. Pictured here is subspecies *S. n. apacheana* (Skinner), an inhabitant of desert regions in eastern California and adjacent Nevada (photo L. Orsak).

The Endangered Species Problem

Keith M. Schreiner*

United States Fish & Wildlife Service, Washington, D.C. 20240, USA

Abstract

Human population increases in the United States have concurrently brought about increases in (1) biological knowledge of the nation's flora and fauna, (2) the ability to detect species losses, and (3) the numbers of species being irreversibly lost. To prevent the latter, the United States Department of the Interior is charged with species protection, partly through endangered species law. Although for insects status information is often sparse or diffuse, eight species are currently protected; the status of others is under review. The Department has made a long-term commitment to endangered insect conservation, although this is currently handicapped because few states have reviewed the status of non-economic insect species and no national center exists for such a purpose.

Introduction

Mr. Chairperson, distinguished visitors, ladies and gentlemen: I am delighted to have the privilege of speaking to you on such an important occasion. Today, I would like to accomplish three major goals: First, I will present a brief overview of the Endangered Species conservation problems faced by the United States. Second, I will give a brief history of United States Governmental efforts to protect Endangered wildlife and plants. Finally, I will discuss the United States Department of the Interior's recently initiated efforts to conserve unique insect forms in this country, as well as abroad.

Wildlife: Discovery and Disappearance

When human beings first arrived on this continent, they were faced with an extraordinary variety of landscapes, each with its own set of native wildlife and plants. Today ecologists refer to each of these landscape sets as an ecosystem. As the works of humans became increasingly dominant on the continent's surface, all of these ecosystems have been altered from their original state.

Some ecosystems, especially those suited to urbanization or agriculture, have been heavily affected. Others, particularly arid and mountainous regions of the west, have not been so drastically changed from their original condition.

As the population of this country grew, so did the body of knowledge relating to the diversity of native wildlife and plants. But our knowledge of different animal groups did not develop at the same pace. For example, virtually all species of birds and mammals were known and described by the end of the nineteenth century. Today, we know the distributions of our approximately 600 native bird and 300 native mammal species in the United States very well indeed. The same, unfortunately, may not be said for the native insect fauna, which may number several hundred thousand species. At present, new insect species continue to be discovered and described at a rapid rate. At the same time, some insect groups, such as butterflies, large moths, a few families of large beetles and wasps, as well as others, are known very well.

Thus, as human numbers have increased, and our body of biological knowledge has grown, our ability to detect the irreversible loss of wildlife species has become more acute. By the early part of this century it became a relatively easy matter to document the extinction of some native North American birds and mammals. Again, for insects the same cannot be said. Insects are still imperfectly known. The distributional information for most species is scanty, or has not been summarized, and their small size and esoteric habits defy easy survey methods.

It was not until early in this century that the field of Ecology had its first awakening. However, this field of biology has developed dramatically just in the last two decades. Now, because of our current understanding of ecology, and because of our knowledge of the status of may animals, we are not only able to document extinctions, but to understand with some clarity the ecological principles which underlie such lamentable passages. Suffice it to say our understanding of such principles also allows us to predict which species are approaching extinction, and to propose alternative actions which might avert such unfortunate events.

We can now state that the number of wildlife and plants which have become extinct in this country has increased through the nineteenth century and the first half of this century at a rate which is directly in proportion to the increase of our human population. This comparison should be viewed as an indicator, not of *direct* human interference, but of the *indirect* result of habitat alteration which must take place to fulfill growing needs of a growing human population. As you may imagine, our growing needs for energy sources, food, and other resources through the remainder of this century can be expected to bring about great environmental changes in this country, particularly to some now relatively uninhabited areas of the western United States. Primary among the forces causing those changes will be development of geothermal energy and agricultural conversion in the intermountain states, development of off-shore oil deposits, and more intensive management of National Forests.

*Associate Director, Federal Assistance

Government Protection of Wildlife and Plants

Let us now turn to an examination of the Federal Government's efforts to conserve and manage endangered wildlife and plants. The Department of the Interior has been protecting wildlife and plants since the turn of the century in National Parks and within the National Wildlife Refuge system. In addition, the Migratory Bird Treaty Act has resulted in conservation efforts on behalf of several Endangered birds.

The Department's first direct efforts to conserve and bring about the recovery of species with dwindling populations began in the 1950's with programs for the maintenance and restoration of Whooping Crane (*Grus americana*) and Trumpeter Swan (*Cygnus buccinator*) populations.

The first major legislative step which foresaw the current Endangered Species program in this country was the passage into law of the Endangered Species Preservation Act of 1966. This law acknowledged a national responsibility to act on behalf of native vertebrate animals which were threatened with extinction. It also required the Secretary of the Interior to judge which species were Endangered and to publish lists of such animals in the *Federal Register*. To accomplish this task, the Office of Endangered Species (OES) was established with a staff of professional biologists. In addition, the Department of the Interior could acquire habitat for animals listed under this Act using limited monies from the Land and Water Conservation Fund. As important as this law was in the development of an Endangered Species program, it had several important failings. These were due to the limited coverage and provisions of the 1966 Act.

With the passage into law of the Endangered Species Conservation Act of 1969, a number of new important provisions and expansions were initiated. The coverage of the Act was broadened to include mollusks and crustaceans, in addition to the previously considered vertebrates. Authority to conserve Endangered foreign wildlife, and to prepare lists of such species was included for the first time.

To cope with such added responsibility, the Department of the Interior increased the number of professionals in its Office of Endangered Species. As a significant addition to the program, controls over the importation of foreign Endangered animals or their parts or products was begun. Fish and Wildlife Service law enforcement agents were stationed at designated United States ports of entry in order to detect any such illegal importation.

The most significant event in our program was the passage by Congress of the Endangered Species Act (ESA) of 1973. This piece of legislation is one of the most powerful environmental laws ever enacted by any country. Of primary importance to this audience is the fact that insects are included in the provisions of the Act. This action by the Congress recognizes that insects, with the exception of certain pest species, are a significant natural resource, and marks the first time that insects have received specific Federal protection. It is also noteworthy that protection of Endangered native plants receive consideration for the first time. Protection of these plants and their habitats automatically provides protection for any host-specific insects feeding upon them.

In any examination of the 1973 ESA it is noteworthy that the main stated purpose is "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved...." This is a noble purpose, but how are provisions of the ESA geared to bring about such accomplishments?

First, the direct route of land acquisition on behalf of any listed species is available. This authority is given to the Secretary of the Interior in the 1973 ESA by Congress. Second, Section 7 of the ESA calls for the cooperation of all Federal agencies in the conservation of any listed species whose habitats occur on land under their jurisdiction, or which might be affected by their actions, as well as by any actions funded or authorized by them. The provision for inter-agency cooperation is one of the most powerful parts of the ESA (or any other environmental legislation, for that matter) and promises to yield the most progress in the actual conservation of Endangered and Threatened insects and other organisms. A third method of habitat protection is accomplished by State Cooperative Agreements provided for by Section 6 of the Act. This Section encourages States to adopt Endangered Species Programs comparable to the Federal one established by the Act. In addition, matching funds may be provided to any State which has a Cooperative Agreement for its Endangered Species Program. Finally, conservation programs for selected high priority species are funded by the Department of the Interior. Such programs are usually initiated on the basis of recommendations of a previously selected "Recovery Team." Such recommendations are usually in the form of a "Recovery Plan," which may or may not be implemented after review by the Fish and Wildlife Service.

There are other important provisions of the 1973 ESA but time does not permit me to detail all of them for you. Most important of these are the provisions for participation by the public in determining which species should be listed, and the prohibitions which include statutes against taking, inter-state commerce, exportation and importation. Permits are obtainable by persons who wish to work with any listed species for scientific purposes, or to enhance the propagation or survival of the affected species.

Federal Protection of Insects

Now, let me turn to the subject of Endangered insect conservation. First, let us ask several obvious questions. Are any insects really Endangered? If so, wouldn't their protection bring up serious conflicts with our country's efforts to control agricultural and forest insect pests? If there are so many species of insects in this country, or the world, does it matter if we lose a few?

Since status information on United States insects is so diffuse, it is difficult to say how many have become extinct, but we know of at least 50 species and subspecies which are presumed extinct. Many insects occurring in very small, localized areas, such as bogs, marshes, and sand dunes, are now threatened with extinction. Other once-extensive ecosystems such as our mid-western prairies have been so reduced by agricultural conversion that only tiny pockets are left. Still other habitats containing insect candidates are the Hawaiian islands and desert hot springs.

The kinds of native habitats where Endangered and Threatened insects are found are small and will usually not be in areas where normal agricultural control methods are practiced. The increasing use of natural control, as opposed to chemical control, should even further reduce potential conflicts in the future.

There are several very good reasons why we cannot willingly sacrifice even a single native insect species--some economic pests excepted, of course. First, it is the Government's responsibility to insure that its activities on behalf of the public do not cause any significant lessening of environmental quality of which insects are an important part. Second, insects are enjoyed by a significant portion of the public on aesthetic grounds. Of course, insects are of premier importance as pollinators. Many plants have specific insects upon which they depend. In addition, even rare insects often play important roles in evolutionary, genetic, and ecological research.

Finally, let me present a brief run-down on the United States Fish and Wildlife Service's Endangered Insect Program.

The Department of the Interior has a significant long-term commitment to Endangered insect conservation. This program was initiated in October 1974, when the Office of Endangered Species added a professional entomologist to its staff. Early efforts concentrated on United States butterflies, since the status of these insects seemed to be well known. As a result, six California butterflies are now listed as Endangered and two Florida butterflies are listed as Threatened, and it is anticipated that several more will be determined in the not too distant future. We have also begun efforts to assess the status of certain sand dune insects in western North America, and other kinds of insects will be reviewed in the near future. Our program is handicapped by the facts that very few states have adequately reviewed the status of their insect faunas, and that there is no national center which actively keeps track of the status of non-economic insects.

Later in this symposium you will hear described the excellent program which has been initiated by my home state, Florida. You will also hear Britain's Endangered Insect Programs discussed, and you may see how much we may achieve if we can approach their excellent example.

I hope that this Symposium may awaken interest and concern for endangered insects, not only on this continent, but abroad as well.

Ecological Aspects of Extinction

Daniel Simberloff

Department of Biological Science, Florida State University, Tallahassee, Florida 32306, USA

Abstract

Extinction is an ecological, as well as an evolutionary phenomenon, with local extinctions being of rather frequent occurrence. Extinction rates on islands are examined, with special emphasis on insects. The author addresses the application by other authors of island biogeography theory to conservation, but concludes that the theory presently is incapable of providing specific insights into conservation practice. Refuted are specific conclusions by others that a large contiguous preserve is preferable to several smaller preserves of the same total area; also, that a refuge should be as circular as possible so as to avoid "peninsular effects."

Introduction

Extinction has traditionally been viewed as an evolutionary rather than ecological matter. Until about 15 years ago, "extinction" conjured up notions of the end of a long phyletic lineage, a rare event over periods of geological time. Gradually changing physical ecology was viewed as one cause of such evolutionary extinction, as in the debate over the Pleistocene extinctions of the great American mammals. Yet, extinction was not considered a frequent enough event to have a role in shaping ecological communities on a day-to-day basis.

Then MacArthur & Wilson (1963, 1967) and Preston (1962) independently suggested that local extinction of entire populations, if not species, probably occurs frequently, on a scale of months or years as opposed to millennia; and that such extinction is an important determinant of local species diversity, much as are trophic interactions and competition for space. The basic idea is that the number of species, S, in a place, be it an oceanic island or a habitat island--like a field or even a hostplant--is a dynamic equilibrium between immigration of species new to the island (at a lower rate the more species are already present[1]) and extinction of species present on the island (at higher rates, the more species are present[2]). Of course, if a species consists of only one or a few isolated populations, such as the Apache Silverspot butterfly (*Speyeria nokomis*

[1]That is, with more species on an island, (1) there is a lower chance that a species arriving on the island is "new" or not already present, and (2) immigration is lower because the island is more saturated, with more species present (meaning increased competition or resource limitations). *Editor*

[2]That is, extinction is higher with more species present, because of competition or resource limitation. *Editor*

apacheana (Skinner)) or others restricted to small locales or rare hostplants, then the dynamics of this immigration-extinction system could be critically important in determining whether the species as a whole survives.

I will now describe a series of experiments on insects which provides evidence on (1) whether local extinction *is* as common as MacArthur and Wilson envisioned; (2) what factors determine the rate of such extinctions; and (3) the implications of this hypothesis and the observations for the preservation of endangered insects.

Experiments on Extinction

Ten years ago, Edward O. Wilson and I experimentally tested the hypothesis that the insect faunas of small Florida Red Mangrove islands have dynamic equilibrium numbers of species, with sizable extinction or "turnover" rates. We attempted to remove all insect populations from a series of islands by tent fumigation with methyl bromide. Species numbers remained approximately constant on the control islands, while the fumigated islands each returned within a year or two to the original species number, then stayed in that vicinity. Just from looking at species lists at successive times, we were able to show that a lot of extinction occurred, perhaps one extinction per 2-10 days for a medium-distance island (200 meters from shore) after equilibrium species number was achieved (Wilson & Simberloff, 1969; Simberloff & Wilson, 1969, 1970; Simberloff, 1969, 1976b).

As to the causes of these extinctions, this proved to be a more elusive question. Of course some of the extinctions could have been predicted immediately, since they involved species which are host-specific herbivores of plants other than the red mangrove present on the islands, or else they involved species (for example, some ants), which nest in the ground—Red Mangrove islands have no ground (Simberloff, 1976a; 1976b). Since all species in this experiment are widely distributed, such extinctions were only local, but a number of cases are now known of insects which are very narrowly distributed and are endangered by prospective elimination of habitat or foodplant.

Those extinctions in the mangrove, which were without immediate obvious cause, are in a sense more interesting, since they suggest that even with conditions ideal or at least adequate, a certain non-negligible probability of extinction exists. For example, on island "ST2" the extinction of *Cycloptilum spectabile*, a cricket which had been seen for three months in good number and which routinely lives on mangrove islands, cannot be ascribed simply to absence of food or habitat; both were present. Similarly, the green lacewing *Chrysopa collaris* is a frequent longstanding resident of tiny mangrove islands, yet a sizable population went extinct. So it is apparent that at least on these little islands, extinction can happen to anyone, and is not a terribly rare event. It is difficult to determine the extent to which changes in species lists represent real extinction of populations which have undergone initial population increase or just transient movement of individuals which are part of widely ranging, mobile populations. Smith (1975) has suggested that most "extinction" discussed in the ecological literature consists simply of transient, intra-population movement, while Lynch & Johnson (1974) have impugned the most widely cited vertebrate extinction data, that of Diamond on birds (1969, 1971). But for the mangrove island insect experiment, I have been able to show (Simberloff, 1976b) that island-to-island movement is on a longer time scale than generation length for most species. Thus, even though most changes in species lists are not *bona fide* extinctions, a substantial number (perhaps ten/island/year) certainly *do* represent true population extinction.

This is not to say that every species is an equally good colonist and that all species are equally at risk of extinction. In another experiment which I will soon describe, in observations on a total of 254 species found on nine islands in three successive years, there could conceivably have been 1148 extinctions (presence one year, followed by absence the next), but only 349 actual extinctions occurred. One group of 96 species contributed 111 of only 121 possible extinctions: they almost always went extinct immediately. These included obligate transients whose food or habitat was absent, but also a number of species, particularly among psocopterans, thrips, beetles, and wasps, which are able to survive and reproduce on mangrove islands. At the other end of the spectrum are a group of 22 species present almost always, who could conceivably have produced 320 extinctions but actually went extinct only 11 times. These colonists, including ants, beetles, roaches, and crickets, are highly adapted mangrove colonists, some found *only* there. Yet they nevertheless *did* go extinct 11 times (Simberloff, 1976a).

So it appears that all species occasionally are locally extinguished, even if some are less likely to survive than others. This is in spite of food and habitat availability. The specific causes of a given extinction are hard to pin down. I have many observations of drowned individuals even after ordinary rainstorms, more after hurricanes. Parts of the trees frequently fall into the water in high winds, carrying their insects with them. Whether any of these events constitutes elimination of the absolute *last* representative of a species would be almost impossible to verify, but I have published reasons for thinking that such physical "catastrophes," rather than competition, are the main causes of extinction where food and habitat seem to be present (Simberloff 1969, 1976a, 1976b). In sum, every extinction has a cause; where it is food or habitat absence, the cause is obvious and the extinction deterministic. Where it is these other environmental forces, the cause of a particular extinction cannot always be assessed, but one can make the stochastic or probabilistic prediction that a certain number of such extinctions will occur.

In those situations where food and habitat are not lacking, what factors determine the rates at which extinction occur? The experiment providing the extinction figures just cited suggests that the size of the island is important (Simberloff, 1976a). Each of eight islands was censused again after a year was allowed for re-equilibration of the insect community. In every instance, number of species declined, and the data were consistent with the hypothesis that increased extinction rates caused the decline. Few if any species were *always* eliminated when areal size decreased. Rather, it seems that all species are more likely to be extinguished when area is small regardless of what causes extinction, forcing population sizes to be small. Brown & Kodric-Brown (1977) have pointed out, with some supportive data from insects attracted to flowers, that more distant islands should also suffer more extinction, all other things being equal, since the nearer an island is to potential source areas, the more recruitment will counteract any population declines, stochastic or deterministic.

Criteria for Conservation

Given that local population extinction must always occur at some non-negligible rate, what can we do to minimize extinction of entire insect species? First, of course, at least a portion of any obligatory hostplant or specialized habitat must be maintained. Generally, the larger the *total* area, the better. This does *not* necessarily require that all the area be contiguous, and in fact in another experiment in which I turned one large island into an archipelago of small ones, one of the two cases completed shows the archipelago to have more species than the original single large island (Simberloff & Abele, 1976). Of course, these islands in the archipelago are very close together so that extinction on one island could be quickly countered by invasion from another. Even if the islands were not so close together, I would guess that Elton's statement (1975) that enormous contiguous masses of forest must be maintained to prevent tropical insect extinction is too pessimistic. After all, insects as a group are very good at getting around; many of them epitomize Hutchinson's notion of a "fugitive species," which makes its living precisely by staying alive in certain places while being extinguished in others, then re-invading the places from which it has disappeared. And a network of refuges rather than a single large one would be more immune to such catastrophes as fires or epizootic diseases. Of course, if the component refuges are too small, extinction rates within them would be so high that few species could survive. So the optimal size and dispersion of refuges would have to rest on detailed field study of the dispersal characteristics and population dynamics of the species in question.

The experiments on insects which I have just discussed, as well as observations of geographic distributions of birds, have been erected into a widely bruited theory of conservation based on MacArthur & Wilson's theory of island biogeography (1967). Papers of this sort include those by Wilson & Willis (1975), Diamond (1975), and Terborgh (1974, 1975). The main supposed design imperative imposed by the theory of island biogeography is that refuges ought to consist of the largest single, contiguous land mass possible. As was pointed out by Simberloff & Abele (1976), the theory of island biogeography is actually completely neutral on whether one large or several small refuges would be preferable. Three responses to this paper (Diamond, 1976; Terborgh, 1976; Whitcomb, *et al.*, 1976) cite avian data which are susceptible to various interpretations, and in any event do not answer our point. Since this exchange, a plethora of papers espousing the same imperative has appeared: Diamond & May (1976), Whitcomb (1977), MacClintock, *et al.* (1977), Whitcomb, *et al.* (1977), Lynch & Whitcomb (1977), Galli, *et al.* (1976), and Forman, *et al.* (1976). Athough all cite the equilibrium theory, none of them address the original criticisms of Simberloff & Abele (1976), or change our conclusion that the theory of island biogeography is incapable at this time of providing specific insights into conservation practice. As we said then, the critical needs now are detailed autecological studies on the specific animals to be conserved, and the above papers constitute only the barest beginnings of such an effort. It is worth observing that all the above papers refer to birds, while the reasoning of Simberloff & Abele (1976) and the results of the mangrove island experiments described above suggest that, independent of island biogeographic theory, insects might do just as well in several small refuges as in one large one, so long as basic habitat requiremets are maintained. In any event, it is disheartening to see the same sorts of arguments and data trotted out in support of the biggest-single-area hypothesis in spite of our having demonstrated the inappropriateness of tying it to island biogeography, and I leave it to my more patient colleagues, Abele & Connor (1977), to point out the same flaws once again and to review and respond to the new efforts.

I end this essay by noting a second notion, based on as little evidence, that has recently become almost as much of a conservation shibboleth as the biggest-single-area. Both Wilson & Willis (1975) and Diamond & May (1976) state as a principle that refuges should be as nearly circular as possible so as to "avoid 'peninsular effects' whereby dispersal rates to outlying parts of the reserve from more central parts may be so low as to perpetuate local extinctions, thus diminishing that reserve's effective area" (Diamond & May, 1976). There is not an iota of experimental evidence to support this hypothesis, and that the peninsular effect is a general principle is even less defensible than the proposition that equilibrium island biogeography is a validated paradigm. The best study of the peninsula effect of which I am aware (Wamer, 1977) suggests that there is *no* nomothetic explanation for the frequent depauperation of peninsulas, and that for one peninsula (Florida) and one taxon (birds), the decrease in species number has nothing to do with dispersal or even the peninsular shape, but rather reflects geographic habitat differences (primarily vegetation). Taylor & Regal (1978) similarly feel that vertebrate diversity patterns on all North American peninsulas except possibly Baja California are most parsimoniously explained as responses to vegetational gradients.

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Insect Conservation in Britain: National Nature Reserves

N. W. Moore

The Nature Conservancy Council, 19/20 Belgrave Square, London, SW1X 8PY, GREAT BRITAIN

Abstract

The background of conservation activities in Great Britain is described. The Nature Conservancy Council focuses on nature reserves, the support of research programs, general advising, and the dissemination of information. Actual conservation of organisms is achieved through nature reserves and through Sites of Special Scientific Interest; the latter encompasses private land holdings. Using the Lepidoptera and Odonata as examples, it is concluded that selecting nature reserves on an ecosystem basis has been successful. Additional research focusing on the management of wildlife within reserves is needed to maintain optimum populations on existing reserves and to determine which types of specialized management techniques must be applied to specific sites or organisms.

Introduction

One of the great values of a gathering such as this is that we are reminded of both the diversity of nature and the diversity of human institutions. Conservation of course is always about humans *and* nature.

In each country conservation consists of an amalgam of official and voluntary effort. In the next three talks you will hear about the conservation efforts of one country--Great Britain. I shall discuss the contribution of Government, Michael Morris will discuss the contribution of the voluntary movement, and Jeremy Thomas's paper will cover research, which can be undertaken by government departments, by universities and by individuals.

Before describing the official British contribution, both to conservation in general and to endangered species in particular, I must summarize the special features of the British situation in order to provide the background of our activities. First, let us consider our living natural resources. We have a varied but impoverished flora and fauna. It has been modified profoundly by humans from Mesolithic times onwards. Less than ten percent of the country, which was once almost entirely covered by forest, is now woodland. The pattern of wood and agricultural land which we have today was formed by about 1000 years ago, and has remained relatively stable during that time.

Second, let us consider the institutions. Britain contains, and has for some time contained an unusually large number of naturalists, and hence many natural history and conservation societies. Official conservation started in 1949 with the formation of the Nature Conservancy (now the Nature Conservancy Council).

Human population density is high; over 54 million people live in an area of 230,000 square kilometres. This has forced the British to have fairly stringent planning control over land. There is no equivalent of the federally owned land of Australia or the United States, so, if the Government wishes to acquire land, it must buy it from private landowners.

Unlike many countries the function of landscape conservation and informal recreation (and hence the setting up of national parks) is administered separately from the function of nature conservation. The landscape function is performed by the Countryside Commissions (one in England and Wales, another in Scotland), and the nature conservation function by the Nature Conservancy Council. Both are responsible to the Department of the Environment. I shall now describe the mechanisms by which the Nature Conservancy Council carries out its statutory conservation functions, and then make a brief assessment of their success or failure in conserving endangered species.

The Nature Conservancy Council has four main functions (Anon., 1973): (1) Establishing, maintaining and managing nature reserves. Reserves are bought or obtained on long leases or by Nature Reserve Agreements with their owners. (2) Advising government departments "on the development and implementation of policies for or affecting nature conservation." (3) Providing advice and dissemination of knowledge about nature conservation. (4) Commissioning or supporting research on conservation.

Nature Reserves

The aim is to protect a series of sites representing all the main ecosystem types present in the country. For example, we have a series of ash woods from the Durness Limestone in northwest Scotland to the chalk in southern England, and a series of sand dunes differing in pH throughout the country. The criteria on which selection is based include extent, diversity, naturalness, rarity, fragility and representativeness. No way has been found of relating these criteria quantitatively--the final choice between sites must be based on the best opinion available, which in turn is based on the application of all the criteria. In practice, the order in which reserves are established is determined largely by external factors, notably threat and opportunity. There are now (6 March 1978) 160 National Nature Reserves (NNRs) covering an area of 125,615 hectares. This represents about 13 percent of the land which surveys have shown to be of outstanding scientific interest in the country (Ratcliffe 1977).

Land Outside Nature Reserves

In a small, densely populated country like Great Britain, only a small proportion can be set aside as nature reserves. Most conservation must be achieved on land outside nature reserves. This is partly done by the Site of Special Scientific Interest procedure; using these procedures, the planning authorities responsible for land of known scientific interest, including proposed NNRs, have to be notified by the Nature Conservancy Council. Whenever development is proposed in any of these sites the Nature Conservancy Council has to be consulted by the planning authorities. Frequently this results in the development being refused or modified. The system does not cover agricultural and forestry development--this is its great weakness; but it does prevent sites from being destroyed unwittingly. In addition to the formal mechanisms of establishing nature reserves, notifying about Sites of Special Scientific Interest, and carrying out statutory duties such as licensing the collection of species protected by law, much conservation has to be achieved by liaison and education. For example, liaison is maintained with agricultural advisers of the agricultural departments, the Forestry Commission, and the National Farmers Union; and lectures are given to universities, naturalists' trusts, young farmers' clubs, etc. The aim is to influence people to conservation measures on land whose primary function, unlike National Nature Reserves, is not conservation.

To What Extent is the British System Effective, and What Are the Problems of the Future?

First, we can ask to what extent does the system of selecting reserves on a habitat basis give protection to the individual species of flora and fauna? We cannot answer this question for most insect groups because we do not know enough about changes in their populations. Despite the efforts of Heath and his collaborators at Monks Wood Experimental Station too little is known about their distributions. More is known about Lepidoptera and Odonata than about other orders, so we can use them as rough indicators. Of the 56 butterfly species breeding in Britain, 53 occur in NNRs (Heath, 1970). Of the 40 dragonfly species breeding in Britain, 32 occur in NNRs (Moore, 1976). Several localities containing the few species not found in NNRs are given some protection by being Sites of Special Scientific Interest, and some of these sites are also non-statutory nature reserves maintained by voluntary bodies. Thus, if butterflies and dragonflies are typical, we can claim that the method of conserving representative ecosystems is a reasonable and effective way of giving some protection to species of insects.

Despite the fact that recent changes in the British countryside have been more radical than any that have occurred in any comparable time before, no butterflies have become extinct since the creation of the Nature Conservancy in 1949. Three dragonfly species have become extinct--one due to natural causes (flooding), one due to pollution by sewage effluent of the river to which it was confined, and one because extensive lowering of the water table of its one locality. Two of these species were in areas notified as Sites of Special Scientific Interest. It is concluded that the situation is fairly satisfactory, but we cannot be complacent: The agricultural revolution, aided by our balance of payments problem, is forcing us to look radically at the conservation measures which we employ.

When the Nature Conservancy was set up, NNRs were thought of essentially as examples for study, the vast bulk of the populations of their constituent species occurring outside. Today, agricultural and foresty practices make modern farms and modern plantations increasingly unsuitable for wildlife. Therefore, the National Nature Reserves become increasingly important as reservoirs or refuges for conserving a significant proportion of the total national populations of many species. This fact has important implications for research.

Research

We must ask the question: *How much habitat is necessary to conserve viable populations of different species?* Since the land surrounding reserves becomes increasingly unlike that of the reserves themselves, more and more reserves become ecological islands in a "sea" of agricultural land. We need to know the implications of this development. This explains our special interest in island biogeographical work.

Owing to the high human population density, it is politically impossible in Britain to establish very large areas entirely for nature conservation. Therefore we are having to think of ways of combining nature conservation with landscape conservation and recreational areas so as to achieve more conservation outside the nature reserves. In turn, this means we need to do more research on the impact of human activities on wild organisms.

Since nature reserves have become increasingly important as refuges, we must make sure that our management of them is conducted so that they support optimal populations. We cannot rely on continuing previous established forms of management in every case, nor on random guesses. So, again we need more research. Later you will be hearing about some of the work on butterflies which has been done to achieve better management.

I would like to conclude with a plea to all conservation organizations that they monitor the effectiveness of the conservation measures which they undertake, both in nature reserves and in the nation as a whole. This is necessary both to assess the success or failure of particular management programmes and for planning conservation strategies for the future.

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Insect Conservation in Britain: Ecological Background and Voluntary Effort

M. G. Morris

Institute of Terrestrial Ecology, Furzebrook Research Station, Wareham, Dorset, BH 20 5AS, GREAT BRITAIN

Abstract

There is great interest on the part of the informed public as well as professional entomologists in protecting the relatively impoverished British insect fauna, particularly endangered species. Voluntary conservation bodies participating to varying degrees in the conservation of rare British insects include the County Naturalists' Trusts or Trusts for Nature Conservation; the Council for Nature; World Wildlife Fund; Insect Protection Committee (Royal Entomological Society) now the Conservation Committee; and Joint Committee for the Conservation of Insects. The contribution of overcollecting to population reduction has been a continuing point of dispute, resulting in a widely accepted voluntary "Code for Insect Collecting." Volunteer organizations and individuals are in the process of assessing the distributional and abundance status of many rare insects, thus allowing more objective judgement on the effects of overcollecting and the need for habitat management and protection. Non-governmental, voluntary efforts in British insect conservation have brought both success and failure, but it appears that the need for endangered insect conservation is now widely appreciated in Great Britain.

Insect Fauna in the United Kingdom

The United Kingdom has a poor insect fauna compared with continental Europe. Sun-loving species, such as the butterflies and grasshoppers, are particularly few. The British climate is generally too wet and cold for the development of a very diverse insect fauna. But even within the relatively small extent of the British Isles, faunal diversity changes markedly with latitude. For instance, four native orthopteroid species breed in northern Scotland, compared with 30 in southern England (Ragge, 1963). Of the groups of large, showy insects--those which are usually thought of when endangered species are mentioned--Great Britain is inhabited by fewer than 60 resident species of butterlies, approximately 40 species of Odonata, and about the same number of orthopteroid insects. Lepidoptera other than butterflies are numerous in species, but not unusually so: there are about 2400 species, of which about 900 are "Macrolepidoptera."

As well as being not very rich in species, the British fauna is also of no great interest zoogeographically. It is true that there is some mingling of arctic/alpine elements with species of more southerly distribution in Europe, and there are some species particularly characteristic of the extreme western part of Europe which are common in Britain but rare or very restricted in range elsewhere in continental Europe. However, there are no endemic species in Britain (with a few doubtful or obscure exceptions), and certainly no endemic taxa of higher rank. A number of endemic subspecies have been described, particularly in the Lepidoptera, but the status of too many of these is doubtful or in need of review. The large quantity of recent work on Quaternary Coleoptera in Britain (and in western Europe generally) has emphasised that the last million years or so have been characterised by a lack of morphological evolution and absence of extinctions with correspondingly wide and wild fluctuations of the range of species (Coope, 1970). The geologically recent status of Britain as a group of offshore islands, which of course is part of its Pleistocene history, gives a partially false impression of zoogeographical isolation. In summary, Great Britain's insect fauna is an impoverished version of that of western Europe, with only a few distinguishing features.

Despite this, British field entomologists find much to interest them in their homeland. Its geology is varied, so that flora and fauna are more diverse than they would be in a more uniform country. Although it is thought that deciduous forest is the natural climax vegetation over most of the lowlands, Britain is almost the least well-wooded country in Europe. Its forests are also rapidly changing in character from being dominated by broad-leaved, deciduous species to becoming dominated by introduced, quick-growing conifers. Despite the continuing protests of the popular entomological press at this change, many deciduous woodlands still survive. There are also important tracts of grassland, and montane features in Scotland, Wales, and a few parts of England. Wetlands, and to a lesser extent, coastlands, are under considerable threat, and there are now very few areas of fen and bog and undisturbed sand dunes, in southern England at least. Fortunately, many insect species are able to survive as populations in quite small areas. Nevertheless, three species of butterfly have certainly been lost to the country in historic times, at least one primarily through changes in land use and the nearly complete destruction of fenland in the southern part of Britain. Losses and gains in the Lepidoptera over the last 100 years are reviewed by Heath (1974).

British Concern for Endangered Insects

Partly because of this, and despite the limitation of its fauna, concern for the endangered insect species of Great Britain is considerable, though not to be compared with that shown for plants, mammals and reptiles, and, of course, birds. This concern derives from a number of factors. First, there is a strong

traditional interest in field entomology in Britain, both professional and amateur. To some extent the possession of a relatively poor fauna has been a stimulus because in many groups the taxonomy of the species is on a comparatively very sound basis. Combined with the amateur interest, in particular, there has been on the part of many entomologists a strong chauvinism which expressed itself in the collection of only British-caught specimens. This meant that a rarity taken in Britain was worth many times its continental counterpart - a fact which has mystified as well as amused mainland European collectors and has, over the years, given rise to many cases of fraud. Nowadays it seems that the "British only" mentality is much less rigid.

Also of importance in the concern for endangered insect species in Britain is the high density of human population and highly developed industrial society implied by the changes in land use already briefly mentioned. Great Britain is a relatively small tract of land which is used for many purposes, including buildings and roads, especially motorways, mining and quarrying, heavy industrial processes and for very intensive agriculture. There is not much room left for wildlife, and although there are many nature reserves, most of these are very small: there is nothing to compare with the great National Parks and National Monuments of the United States or the big game parks of Africa. As Dr. Moore has told us, pressures on all forms of wildlife are very keenly felt, at least by conservationists, and are very much greater than in more sparsely populated parts of Europe, particularly Spain but also even France.

Because of this interest in field entomology and these pressures on the countryside, the science of conservation is relatively well-developed in Britain. Dr. Moore's contribution to this symposium has shown how statutory conservation is organised and practised in the United Kingdom, whilst Dr. Thomas' contribution has concentrated on some specific aspects of the detailed scientific work which has been done. However, no statutory administration of conservation, supported by scientific research, can function for very long without some measure of approval and approbation from the informed public. The voluntary nature conservation movement in Britain is fairly strong, but diffused, and its ramifications are complicated.

Voluntary Conservation Bodies

The most important voluntary conservation bodies in Britain are the County Naturalists' Trusts or Trusts for Nature Conservation and their umbrella organisation, the Society for the Promotion of Nature Conservation (SPNC). The whole of the United Kingdom except Northern Ireland is covered by these trusts, which are autonomous and generally cover one or two counties; the Scottish Wildlife Trust is responsible for the whole of Scotland. Many reserves, most admittedly rather small and some not very secure, are held by the Trusts, which thus fulfil a most valuable supportive role for the statutory reserves. Other important landowners, such as the Forestry Commission, the National Trust, and the Royal Society for the Protection of Birds, contribute to this, too. County Naturalists' Trusts do not, of course, exist especially for the conservation of insects, but many of them have done good work in conserving endangered species. For instance, the status of the rare noctuid moth (*Gortyna borelii* Pierret) in Britain has been determined largely by the Essex Naturalists' Trust and measures for its protection set in motion by the same organisation. The important initiative taken jointly by the Cornwall and Devon Trusts to attempt to conserve Britain's rarest butterfly, the Large Blue (*Maculinea arion* L.), has been described by Dr. Thomas' contribution to this symposium.

The Naturalists' Trusts and SPNC, together with such bodies as the Council for Nature and the World Wildlife Fund, are concerned with nature conservation generally, and inevitably tend to concentrate on vertebrates and flowering plants. However, insect conservation has a respectable pedigree in Britain, and several of our pioneer conservationists were entomologists. Although the achievements cannot compare with those of the ornithological world, some progress has been made.

In 1926 the Royal Entomological Society of London set up an Insect Protection Committee. The Committee did not itself own or hold land, but it did advise bodies that did, notably at Woodwalton Fen, Huntingdonshire, a large and important reserve of the SPNC (then the Society for the Promotion of Nature Reserves). Here, more or less contemporaneously with the establishment of the Protection Committee, the Large Copper butterfly (*Lycanena dispar* Haworth), which had become extinct in Britain in about 1850, was successfully introduced from the Netherlands. Under somewhat artificial conditions, and with some vicissitudes, the butterfly has been kept going until the present time. However, in the 1950's the reserve was taken over by the Nature Conservancy, so that work done on the ecology and conservation of the butterfly (Duffey, 1968) cannot be said to be part of the voluntary effort.

The Royal Entomological Society's Insect Protection Committee did valuable, if rather low-key, work until 1968, changing its name in the process to Conservation Committee. Its members, together with others, gave evidence to the Nature Reserves Investigation Committees which eventually led to the birth of the Nature Conservancy in 1949.

By 1968 it was evident that insect conservation in Britain was becoming both more urgent and more controversial. The Royal Entomological Society decided that a more representative committee was desirable and invited all the national entomological societies to combine in forming a joint committee, composed partly of members nominated by the societies and partly of representatives from different areas of the country. The Joint Committee for the Conservation of British Insects (JCCBI) held its first meeting in November 1968. In its terms of reference it listed destruction of habitats, changes in land use, the misuse of toxic chemicals, and pollution as the main threats to insect species. However, these threats are not peculiar to insects and the Committee also expressed concern about overcollecting.

The Controversy Over Collecting and a New Code

There are two distinct aspects to this problem: The possibility that populations of rare species are being unnecessarily depleted, or even brought to extinction, by over-collecting, and the disrepute into which entomology is brought as the result of the actions of a selfish minority of collectors. The latter aspect is the more insidious and is probably more damaging in the long run to conservation. It has led some conservationists to overreact; one has recently advocated a complete ban on collecting butterflies (Sparrow, 1976), despite the educational and recreative, to say nothing of the scientific, value of utilising a self-renewing natural resource. The Joint Committee's view was that insect collecting, particularly in the more popular

groups such as butterflies, should be controlled by a voluntary code of practice, which, after long discussion and consultation, it promulgated as "A Code for Insect Collecting." A generous grant from the World Wildlife Fund enabled the Committee to distribute large numbers of copies of the Code as separate pamphlets. The Code was published in all the British entomological magazines and was endorsed and approved by all the national entomological societies. The Code was enthusiastically welcomed by conservationists, and used as a model for codes of practice in other fields.

Despite the success of the Code, the dispute about collecting butterflies has continued and in 1976 broke out in the correspondence colums of *The Times* newspaper. Elsewhere I have argued that conservationists and entomologists need to find common ground and compromise if conservation is not to suffer (Morris, 1975). Much criticism of collectors is ecologically ill-founded, but conservationists have many misdeeds to complain about, and these are by no means restricted to the distant past.

A weakness of the Code was that it referred to rare, local and endangered species, without defining the different types of status; nor did it list the species considered to be at risk. This was soon rectified by the publication of three separate lists of "rare and endangered species." These covered the butterflies and larger moths, the Odonata and Orthoptera, and a rather miscellaneous assemblage of insects, mostly smaller Lepidoptera. Ten species of butterflies were thought to be endangered throughout their British ranges, and two in England only. Three rare "forms" of common species were included. Sixty-seven "Macrolepidoptera" were listed, 12 dragonflies, and 10 orthopteroids. Eleven species were included in the general or miscellaneous list. In retrospect it appears that too many species were described as rare and endangered, and this has had the effect of devaluing endangered status. Several societies felt unable to give the same support to the species lists as they had given to the Code. The detailed status of too many of the species included was not known with any certainty.

Species Status Surveys

Fortunately, there are good distributional data for the Macrolepidoptera and Orthoptera in Britain, thanks to the army of amateur entomologists who contribute records to the mapping schemes of the Biological Records Centre of the Institute of Terrestrial Ecology. This may well be described as a cooperative effort between the official and voluntary sides of conservation. Although for the country as a whole the mapping is at a fine level of resolution, for very local species it needs to be supplemented by further survey. Such surveys have the aim of determining the numerical strength of colonies as well as the presence or absence of a species.

The JCCBI has organised several surveys of species thought to be endangered and would like to undertake more. It has received grants from the World Wildlife Fund for some of these surveys. Organisationally, the most successful was a survey of the status of the Chequered Skipper (*Carterocephalus palaemon* (Pallas)), a grass-feeding hesperiid, coordinated in 1973-1974 by Miss L. Farrell (Farrell, 1975). *C. palaemon* had long been known from localities mainly in midland England, but was always local and subject to disappearance, temporary or permanent, from well-known sites. Fears had been expressed that it was in decline in the 1960's, but only anecdotal evidence was adduced for this. A team of workers visited most of the recorded sites during the flight period, and subjective observations were made of the suitability of each locality for the butterfly. A dossier on all the sites recorded in the literature was also made. Unfortunately, no butterflies at all were seen in 1973 or 1974, despite the intensive search. In 1975 a very few butterflies were found at one site, but there is no doubt that *C. palaemon* has declined almost to extinction in the English midlands. Although this region had always been regarded as the stronghold of the butterfly in Britain, it was discovered in the Scottish Highlands during World Warr II, and surveys made since 1973 by the JCCBI, the Scottish Wildlife Trust, and independent workers have established the existence of flourishing colonies in several new localities. It appears that the Scottish sites more closely resemble continental ones than do the English localities, and it may be that the latter are the more anomalous and not the more typical ones, as has always been hitherto assumed. Those who know the butterfly well suggest that lack of management, resulting in its habitat becoming overgrown, is the main reason for its decline in England, but there is no direct evidence for this, and the decline has now gone too far for the hypothesis to be tested. If the butterfly does not recover in numbers, reintroduction may have to be considered. However, the Scottish race is rather different from the English one, and so this is likely to be difficult.

In the 1960's anxiety was expressed for another butterfly, the Adonis Blue (*Lysandra bellargus* Rottemburg) which was reported to be becoming very scarce. Frazer (1961) recorded a decline to extinction from 1956 to 1959 in one population which was studied by the members of a local society, the Kent Field Club. *L. bellargus* is confined to the chalk hills of southern England, but is more restricted than its foodplant, a strict calcicole. A survey conducted for the JCCBI by R. D. Buxton in 1973 covered most, but not all, of the known range of the species. It was apparent from this survey, and other evidence, that recovery from the decline had been taking place. This highlights a feature of butterfly populations, in particular--that they are especially dependent on good weather. Dr. Thomas' contribution has shown that *prima facie* assessment of the reasons for declines in butterfly numbers are often false or misleading, but it is probably true to say that weather has been underestimated by many conservationists as at least a contributory factor in the decline of some species.

One other survey of the status of species which should be mentioned briefly is the habitat survey of British Odonata. This has shown, for example, that the Norfolk Broads do not now support a high diversity of species, as they once did. It is thought that pollution is a primary cause of this; other forms of wildlife are, of course, also affected.

Outlook for the Future

The work of any committee is astonishingly varied and for every success there are several failures. Many of the achievements are not only intangible but also difficult to appraise. There are many signs that the need for conservation of endangered insect species is now widely appreciated in Britain. Some actions are well-meaning, but ill-considered, for instance many of the attempts to introduce species into new areas or to "reinforce" existing populations. Nearly all but the most intransigent collectors accept that the Large Blue must not be collected--as, indeed, they must, as it is protected by law. Perhaps insect conservationists have not put over their views very well in Britain; we have much to learn from the Xerces Society and other organisations about public relations and educating opinion.

Even our dealers in butterflies are getting the message, however. At least one dealer actively supports conservation, and an Entomological Suppliers' Association now exists with its own agreed statement of "Conservation Responsibility" and a short "Red List" of foreign species which are not to be dealt in. The trade in tropical and other foreign butterflies has for long been a concern of British conservationists, but accurate information is scarce: The impossibility of applying the conservation values and standards of the Western World to developing countries, such as Papua New Guinea or Taiwan, is not always realised. If I may venture an opinion here, utilisation (e.g., by farming for native profit) and conservation of a natural resource are but two aspects of the same common scientific problem--prediction and control--and are, scientifically at least, compatible. Whether the volutary conservation movement in the United Kingdom can contribute fully to solving these and related problems remains to be seen. Perhaps detailed ecological expertise, more likely to be the province of the professional scientist, is the most likely contribution. However, concern for the world's endangered insect species is keenly felt in Great Britain, the more so, probably, because of our own small and relatively unexciting fauna.

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Insect Conservation in Britain: Some Case Histories*

J. A. Thomas

Institute of Terrestrial Ecology, Furzebrook Research Station, Wareham, Dorset, BH 20 5AS, GREAT BRITAIN

Abstract

The mere acquisition of nature reserves for rare insect species is but one step in insuring their protection and long-term survival. Several British butterflies currently commanding conservation attention possess biological adaptations which also must be addressed if they are to survive. Such specializations can be uncovered only through autecological studies, based, if possible, on analyses of colony populations dynamics. Focusing on the Black Hairstreak (*Strymonidia pruni* L.), British Swallowtail (*Papilio machaon britannicus* L.) and Large Blue (*Maculinea arion* L.), the present status and unique requirements of each species is discussed. A synopsis of present management efforts to satisfy these requirements is presented. Such management practices will hopefully allow enhancement of remaining populations as well as permit the re-establishment of these butterflies at former habitation sites. It is urged that such studies be initiated on other species *before* their status become so precarious that management practices, however correct, come too late to avert the species' extinction.

Introduction

Most insects occurring in Great Britain have declined considerably over the present century, often due to their incompatibility with modern agriculture and forestry. One measure being taken by the Nature Conservancy Council to counter this decline, and that of other wildlife, is to establish a series of nature reserves throughout the country, so that at least one

*This paper was originally presented at the symposium by M. G. Morris.

outstanding example of each ecosystem will be protected (Moore, 1978). Increasingly, these National Nature Reserves are being supplemented by those of voluntary conservation organisations.

The acquisition of a nature reserve is usually only the first step in conserving its wildlife. This is because few ecosystems in Great Britain are at the climax of their natural succession, and most must be managed if they are to retain their particular interest. On many reserves this is achieved by maintaining the traditional form of management; however, alternative methods are sometimes possible. For example, Wells (1971) has shown that the characteristic flora of chalk grassland may be maintained by substituting cutting for grazing. However, insect populations are often more sensitive than plants to minor changes in management, as Morris (1971) found when varying the cutting regime of a grassland. Much greater diversity was achieved by leaving some areas unmanaged for a few years; and he recommended that some reserves be managed on a rotational basis over several years.

With the limited resources available to conservation and research, these general approaches to maintaining ecosystems must satisfy the conservation requirements of most British insects, and there is clearly great scope for more research on the more subtle effects of management on associations of insects and other wildlife. There are a few species, however, that are of such particular interest to conservationists that they merit individual attention. These generally belong to spectacular groups, and most are rare and endangered species. They usually have rather specialised requirements which can only be uncovered through detailed research, particularly on their population dynamics. So far only seven British insects have been studied in this detail; all save one are rare butterflies. Some aspects of the research into three of these butterflies, and its application to their conservation programmes, are described in this paper.

Figure 1: Map of Great Britain, showing distributions of some of its rare butterflies. Cross-hatching represents general range of Black Hairstreak (*Strymonidia pruni*); solid square represents 1960 range of the British Swallowtail (*Papilio machaon britannicus*), with other former populations indicated by an "X"; open circles are former population sites of the Large Blue (*Maculinea arion*), while solid circles show its distribution in 1960. Only one of these populations presently survives. The general former range of the now-extinct British Large Copper (*Lycaena dispar dispar* Haworth) is shown by the open square. The disappearance of this butterfly around 1840 heralded the beginning of active butterfly conservation efforts in Britain. Map redrawn from those in Heath, 1973, by L. Orsak.

The Black Hairstreak Butterfly (*Strymonidia pruni* L.)

The Black Hairstreak butterfly (*Strymonidia pruni* L.) (Figs. 2, 3) is a rare British insect confined to a few forests in the east Midlands, although its larval food plant, *Prunus spinosa* L., is a common shrub throughout lowland Britain. In the 1930's and 1940's *S. pruni* was considered by several entomologists to be our rarest indigenous butterfly. It is now clear that there were several more colonies than had then been supposed (Thomas, 1974, 1976a).

By 1969 the Biological Records Centre of the Nature Conservancy had obtained records of 12 colonies of *S. pruni*. These formed a basis for a more thorough survey of sites, similar to those made in Britain for *Carterocephalus palaemon* Pall. and *Lysandra bellargus* Rott. (Morris, 1978). About 30 entomologists traced old sites and searched new woods for *S. pruni*. This resulted in the discovery of several new colonies which could be categorised as large, medium or small populations. In all, a list of 59 British colonies was compiled, of which about 30 still survived. It was clear, however, that many of these were threatened by changing land use or silviculture.

The habitat of most surviving colonies was then analysed and compared with former population sites. Although there was a wide range of situations in which a colony could survive, large populations were invariably associated with high densities of sheltered, unshaded *Prunus spinosa*. In addition, most colonies were restricted to small, discrete areas of their woods which themselves were vulnerable to destruction. Yet, if these remained unharmed, the butterfly could tolerate drastic operations to the rest of the wood, such as clear felling. Indeed, *S. pruni* proved to be a sedentary species that was extremely slow to colonise new habitat, but which would remain breeding in the same small area for very long periods if its habitat remained intact.

It was apparent from the behaviour and habitat requirements of *S. pruni* that few of the remaining British colonies were likely to survive modern forestry operations without protection. Fortunately, the characteristic of persistence in small discrete areas that renders *S. pruni* so vulnerable to local extinction also makes it a relatively easy species to conserve. In the medium term it is sufficient merely to protect its breeding areas from destruction. In the longer term it is necessary to regenerate new suitable habitat in or near present breeding sites (Fig. 3). This is now ocurring on several of the nature reserves in which *S. pruni* occurs, some of which were established as a result of the survey. On some, an attempt is being made to improve the existing situation by trying to create what is believed to be the optimum habitat for *S. pruni*. The success of these projects will not be clear until the mid-1980's, but there are already grounds to hope that these populations will increase, or at least persist.

Most colonies of *S. pruni* cannot be protected by nature reserves, but it has been possible to suggest a range of possibilities to foresters to enable at least a small population to persist. Most wood owners have proved sympathetic to such plans, and there is now little danger that existing colonies will be destroyed through ignorance.

The British Swallowtail Butterfly (*Papilio machaon britannicus* L.)

A more fundamental study of a rare British insect is the work of J. P. Dempster on the British Swallowtail butterfly, *Papilio machaon britannicus* (Dempster, 1975; Dempster, *et al.*, 1976). The British race of this species was once locally common over extensive areas of fenland in Eastern England (Fig. 2), but the draining of these in the seventeenth and eighteenth centuries greatly reduced the area of suitable habitat. In the present century it survived in only two areas: in the isolated Fenland fragment of Wicken Fen, Cambridgeshire, and in the Norfolk Broads about 120 kilometres away. *P. machaon* became extinct at Wicken in the mid-1950's and repeated attempts to reintroduce Norfolk stock failed. By the early 1970's it was clear that the remaining colonies in the Broads were also declining.

Dempster studied the survival of *P. machaon* eggs through to adults on two sites on the Norfolk Broads, and compared these with the survival of eggs introduced to Wicken. Although the numbers available for study were rather small, he found no evidence to suggest that it was the poor survival of the immature stages that had made Wicken unsuitable for *P. machaon*. Dempster also compared the habitat at Wicken with sites in the Broads and found that the larval foodplant, *Peucedanum palustre* (L.) Moench, occurred in sufficient abundance at Wicken to support a colony, although its distribution was rather patchy. Yet, he also found that the condition of *Peucedanum* in the two areas was very different. Plants at Wicken were smaller, produced less seed, and were shorter lived than in the Broads; they also proved to be unattractive to adult *P. machaon* which

Figure 2: The Black Hairstreak Butterfly (*Strymonidia pruni*) perches on its oak foodplant. Photo by M. S. Shelton.

Figure 3: A clearing on a Black Hairstreak colony site was made to allow the re-establishment of breeding habitat.

select larger flowering plants for ovipositing. Dempster concluded that it was the condition rather than the status of the foodplant that made Wicken unsuitable for *P. machaon*.

Wicken Fen is an isolated fragment of fenland which has been left 2.5-3.0 metres higher than the surrounding land due to draining and cultivation of the latter. This has caused the Fen to become drier, and is responsible for the poor condition of *Peucedanum*, as well as other detrimental changes there. There is one area, however, where the water table can be controlled, and this has now been flooded to improve conditions for *Peucedanum*. Unfortunately, due to previous land-use, *Peucedanum* was absent from this area and would have been slow to spread there by itself. Two thousand plants were therefore introduced in 1974. The survival of these plants was poor because of duck damage, but a nucleus was established from which further growth could spread. As a result of this, and because exceptionally wet weather had caused *Peucedanum* elsewhere in the Fen to be more vigorous than usual, the site as a whole was considered to be suitable for a reintroduction of *P. machaon* in 1975.

Two hundred and twenty eight adult butterflies of Norfolk origin were released at Wicken in June 1975. They laid approximately 20,000 eggs and the survival of these was sufficiently high for adult numbers in 1976 to exceed the original introduction. However, oviposition was low in 1976, probably because the plants were stunted by the severe drought that occurred in western Europe that year. Thus, it is too early to be certain of the long-term success of this reintroduction, but the early signs are that Dempster has been correct in his analysis of the shortcomings of Wicken, and may have artificially re-established enough suitable habitat to support a population of this butterfly.

The Large Blue Butterfly (*Maculinea arion* L.)

The third example concerns the conservation of the rarest British butterfly, the Large Blue (*Maculinea arion* L.). This grassland species (Fig. 4) has always been very local in Great

Britain, but has declined particularly over the past 20 years. In all, there are records of about 90 British colonies; more than 30 still survived in the mid-1950's (Fig. 2). Since then there has been a continual decline and it is now feared that only one colony remains, consisting of fewer than 40 adults in 1976.

M. arion is a species of great conservation interest in Britain, and considerable resources have been spent in an attempt to halt its decline. This interest developed because of the beauty, rarity, and remoteness of sites of this butterfly--but above all because of its unusual life cycle.

Adults emerge in late July and lay their eggs on the flower heads of *Thymus drucei* (Ronn.). The eggs hatch after about ten days and the young larvae bore into the flowers to feed on developing seed. After about three weeks the larvae fall off their plants and settle near the ground, where they are found by ants of the genus *Myrmica* (Fig. 5). These are attracted by a sweet secretion from a dorsal gland on the larva, and, after "milking" it for up to four hours, an ant carries the small larva into its underground nest. At this stage the larva is only about 2 millimetres long, but it grows rapidly by feeding on ant grubs (larval stage). It overwinters in the ant's nest and by the following May has grown to nearly 2 centimetres long. It then pupates, still underground, and emerges after about three weeks, when it crawls to the surface and expands its wings.

Fears of the extinction of *M. arion* in Great Britain were already being expressed in the 19th century (South, 1884), and more than 50 papers or articles have been written speculating on the causes. Several sites have been lost by obvious changes in land use, such as ploughing or afforestation; others may still appear superficially suitable but have lost the butterfly. This has led to several theories placing blame on factors other than habitat changes. Among the factors blamed are overcollecting (Graves, 1925), a deterioration of the climatical (Dover, 1974), the genetic deterioration of colonies through isolation (Benham, 1973), and the physical isolation of sites, causing them to be too small to support viable populations (Muggleton & Benham, 1975).

These and other theories have formed the rationale of various past conservation proposals. The most pessimistic are those suggesting that this species can no longer withstand the British climate, or that sites are too isolated to be viable, or that genetic deterioration has occurred. If these are true there is nothing that can be done to save *M. arion* in Britain, and scarce resources would be better spent elsewhere.

Another popular theory has been to place the entire blame for declines on collectors, who certainly caught large numbers of butterflies in the past. This led to one remedy, in the 1930's, of fencing and protecting one of the largest known colonies. Unfortunately, this also prevented the traditional management of the site which rapidly became overgrown, causing the extinction of that colony. Nevertheless, collectors do pose a threat to small isolated colonies, for *M. arion* is rather easily caught; on several occasions more than 90% of the adults on a site have been netted (and released) during population studies (Thomas, 1976b). Thus it has been necessary in recent years to warden all sites through the flying season, although this alone is insufficient to ensure the survival of a colony. Recognition of the potential danger of collecting was expressed in the Wild Creatures and Plants Act, 1975, which named *M. arion* as the first British insect to be given statutory protection in the United Kingdom.

Many other measures have been taken in an attempt to conserve *M. arion*, notably by the Joint Committee for the

Figure 4: The Large Blue Butterfly (*Maculinea arion*).

Conservation of the Large Blue Butterfly which was founded in 1963 by representatives of all the conservation organisations involved with this insect. The Joint Committee initiated a large number of projects, including learning more of the biology of the insect, surveys for new sites, wardening existing colonies, and trying to protect these from destruction by major habitat changes such as ploughing. It also considered that most sites were undergrazed because of a reduction of rabbits resulting from the dixase myxamotosis and because of changing farming practices. The most serious effect of this was thought to be the gradual decline of the *Thymus drucei* foodplant that was occurring on these sites. Consequently, considerable effort was spent in replanting old breeding areas with *T. drucei*.

None of these measures was successful, however, except that the existing site was saved from otherwise certain destruction by the prevention of agricultural "reclamation." By 1972 it was clear that only an intensive study of the ecology of *M. arion* would pinpoint the specific causes of decline, and that remedies were unlikely to be successful unless these were identified. A programme was therefore started to investigate the population dynamics and habitat requirements of this butterfly (Thomas, 1976b, 1977).

The main research has been to analyse the population changes on a flourishing site and to compare these with those on a declining site. Poor data were obtained for the latter, as extinction occurred after one year, but it was noted that a high proportion of eggs were laid on *T. drucei* that was not growing within the foraging range of a *Myrmica* colony. The larvae resulting from these eggs must have died later, for they have very limited powers of dispersal themselves.

The study of a viable colony of *M. arion* is showing that the changes in numbers at two stages in the life cycle are of particular importance in regulating the size of its population. These are during oviposition and the period spent underground in an ant's nest. Ovipositing is greatly influenced by the weather, but its importance may have been exaggerated in this study as two of the four summers were exceptionally unfavourable. However, a viable colony must clearly be able to withstand a series of adverse seasons, and the current population has been shown to be too small to do this.

The more important period for influencing population levels is the survival of the butterfly in the ant's nest. There are four common British species of *Myrmica*, all of which can support *M. arion* in captivity, but only two live in habitat suitable for *T. drucei*. These are *Myrmica sabuleti* Meinert and *M. scabrinodis* Nylander. Both are adapted to living in arid close-cropped turf, and *M. sabuleti* is restricted to this. Population studies are showing that *M. sabuleti* is a much more important host than *M. scabrinodis*, although the latter will support an occasional butterfly. Even *M. sabuleti* has a low and variable capacity to suppot *Maculinea arion*; only rarely are more than two butterflies produced from an ant's nest. The cause of this variability between ant's nests of the same species to support *M. arion* is not yet understood, but is probably dependent on the biological condition of the nest, which varies with age and external conditions.

It appears, therefore, that a suitable habitat for *M. arion* is one in which *Myrmica sabuleti*, and perhaps *M. scabrinodis*, occur at high densities, and that the upper limit to the capacity of a site probably depends largely on the number of nests that are available. This is in part determined by the distribution of *T. drucei*, for only those nests that have this plant growing in their foraging ranges can be used. Conversely, eggs laid on *T. drucei* growing elsewhere will die later as young larvae through a failure to be "adopted" by ants.

In the past three years, 105 former and potential sites have been examined to investigate the distribution of the *T. drucei* within *Myrmica* territories. Only the current site had 100 percent overlap, and most had very low ant densities with more than 80 percent of the *T. drucei* no longer within a territory. It seems likely that this lack of *Myrmica* is the cause of decline of *Maculinea arion* on most of the sites that still look superficially suitable (because *T. drucei* is conspicuous but *Myrmica* is extremely inconspicuous); it is clear that this results from undergrazing. A strong correlation was found between the height of turf on former sites and the percentage of *T. drucei* growing within the territory of *M. sabuleti*. *M. sabuleti* is intolerant of shading and colonies are lost rapidly if the turf grows a few centimetres tall. *T. drucei*, by contrast, is far more persistent.

These preliminary results suggested the need for different conservation measures than have been taken hitherto, and these are now being implemented by the Joint Committee and the Nature Conservancy Council on at least two sites. Areas are being enclosed and grazed to the heavy intensity that appears to be necessary; *M. sabuleti* has already increased very rapidly on the first site where this has occurred. *T. drucei* is a very slow coloniser of new habitat and in 1976, 5000 plants were introduced into new areas around the present site to accelerate this (Fig. 6). This increased the number of *M. sabuleti* nests available to *Maculinea arion* by about fivefold, and it is hoped that the butterfly population will eventually rise by a similar factor.

Discussion

The projects outlined in this paper are examples of a fairly recent approach to understanding the conservation requirements of certain insects in Great Britain. This is to make autecological studies of single species, based, if possible, on analyses of colony population dynamics. The aim is to identify those factors that control the size of a population of each species, and to discover how these factors operate. With additional knowledge of the biology of the insect, it is then possible to define some conditions in which a colony is expected to survive, or perhaps increase. It may then be possible to create and maintain these conditions on nature reserves and other sites.

This approach represents the application of methods and principles learnt from more comprehensive, academic studies of the population ecology of insect species that are more easily studied to insect conservation. It is an approach that had previously been used in a contrasting field of applied entomology--pest control. In that case, the aim is also to identify the key factors controlling populations, but then to manipulate them to the insects' disadvantage. Both applied fields involve an additional step to the purely academic study, for there must also be a sufficient understanding of land management to be able to create and maintain the desired conditions in the field. For the conservationist, this may pose as great a problem as the original diagnosis, as there are usually constraints on the methods of management that are permitted and on available resources.

So far, conservationists have studied few insects using these methods. This is partly because the concepts are fairly new, but mainly because such studies are expensive and time-consuming. In the future, it is hoped that improved techniques will enable essential data to be concurrently obtained for many species and at little cost. To date it has only been possible to study one species at a time, and priority has been given to those that are rare and spectacular.

It is too early to know how well this approach to insect conservation will fulfill its theoretical potential. It has already proved a useful way of identifying the causes of decline of a few insects. In each example cited, the habitat was found to have changed in inconspicuous and unobvious ways on many sites. Suitable conditions for *Papilio machaon* and *Maculinea arion* in particular were found to be rather different and more precise than had been believed, and it was unusual for such conditions to be generated in sufficient quantities to support a colony by modern methods of land management. Even the management programmes of several nature reserves were resulting, through ignorance, in the creation of habitat that was of no benefit, or was actually harmful, to existing colonies.

Figure 5: Young Large Blue Butterfly caterpillar is "milked" by a *Myrmica* ant.

Early results from projects involving *S. pruni*, *P. machaon* and *M. arion* suggest that it should certainly be possible to establish and maintain the new conditions that have been specified, at least on nature reserves, given adequate resources. It remains to be seen whether the populations of these butterflies will react in the ways that have been predicted. Yet, there are some grounds for optimism. Unfortunately, in the case of *M. arion*, it may be that new measures, even if correct, will have come too late, since the population had previously declined to such small numbers that inversely density-dependent mortalities have begun to operate; chance may also play a role. If so, the lesson will be to study species *before* they have declined to the verge of extinction.

Figure 6: Planting Thyme (*Thymus drucei*) into areas around the last surviving colony of the Large Blue. Thyme is the foodplant of the Large Blue caterpillars for about three weeks; they then fall off the plants and are carried into *Myrmica* ant nests, where they reach maturity by feeding on the ant larvae.

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The Florida State Endangered Insect Program*

Howard Weems, Jr.

Division of Plant Industry, Florida Department of Agriculture and Consumer Services, Gainesville, Florida 32602, USA

Abstract

The Florida Game and Fresh Water Fish Commission (FGFWFC) and Committee on Rare and Endangered Plants and Animals oversee the state's endangered species program. Objectives of the program include the preparation of a rare/endangerered plant and animal inventory, formulation of recommendations for protection of these organisms, the development of an endangered state habitats list, and the encouragement of further research and greater public understanding of the state's rare and endangered species. Work of the Technical Advisory Committee on Endangered Species (FGFWFC) is to be published as a comprehensive report. One major problem which limits the ability to conserve the state's endangered invertebrate and plant species is the lack of legal protection currently afforded vertebrate species.

Introduction

This presentation is essentially an update of an invitational paper presented at the Fifteenth International Congress of Entomology, and as the Presidential Address at the 59th annual meeting of the Florida Entomological Society.

Since increasing numbers of states are showing an active interest in the protection of their flora and fauna, including insects and other invertebrates, emphasis in this paper is given to the organization of the *Florida* program. This is designed to provide accurate, detailed information about Florida arthropods as a basis for actions to protect them. It is hoped that this outline may serve as a model for conservation officials in other states who wish to compile similar information on their flora and fauna.

Besides their basic role as working members of ecosystems, our native plants and animals are important to us in a variety of other ways. Many species are commercial sources of food or other products, or provide important recreational benefits, which in aggregate, represents a value of millions of dollars to the economy of the state. Of greater importance still is the aesthetic value of our national biota. The quality of human life is greatly enriched by natural beauty, and Florida's spectacular natural landscapes and wildlife are among its most compelling attractions to visitors and residents alike.

As a result of past geological events, moderate climate, and partial isolation of the peninsula from the main North American land mass, the Floridian biota contains numerous endemic or relict species and races and forms possessing unusual adaptations for specialized environments. A number of plants and animals now entirely or nearly restricted to the state show relationships to remotely separated forms in the southwestern United States, the West Indies, Mexico, and Central or South America. This raises some intriguing questions about how these unusual distribution patterns have arisen. Florida is thus a treasure house of unique plant and animal forms which make it a vast natural laboratory for the study of many fundamental problems of ecology, evolution and biogeography.

Beyond various practical arguments for the preservation of wildlife lies the question of moral responsibility. Humans, as the only biological species that has acquired the ability to alter earth environments over a massive scale, now enjoy dominion over all other species. Such awesome power should carry with it the moral obligation of using it wisely and with the least possible detriment to other life forms.

As a result of the ever-increasing tempo of degradation and destruction of the natural environments of Florida, more and more of our valuable wildlife species are being threatened. Some of the most distinctive members of the original flora and fauna found by the early explorers, such as the Florida Red Wolf (*Canis floridanus* Miller) and Carolina Parakeet (*Conuropsis carolinensis carolinensis* (Linnaeus)), have already become extinct. Others, such as the Florida Panther (*Felis concolor coryi* Bangs), Florida Everglade Kite (*Rostrhamus sociabilis plumbeus* Ridgway), and arthropods as Schaus' Swallowtail (*Papilio aristodemus ponceanus* Schaus), Hogtown Creek Dragonfly (*Cordulegaster sayi* Selys), and the Dusky-banded Tailless Whipscorpion (*Paraphrynus raptator* (Pocock)), are in immediate danger of being lost. Many other native plants and animals are becoming increasingly rare and may soon enter the endangered category if present trends are not halted. In addition, there is good reason to suspect that numerous other species or subspecies with limited distribution or restricted habitats in the state may be threatened; yet, not enough is known about them to be sure of their exact status.

In recognition of the importance of Florida's native plants and animals and the increasing threats to the existence of many forms, the Florida Committee on Rare and Endangered Plants and Animals was established in 1973 under the leadership of James N. Layne, Director of Research at the Archibold

*The following is an update of the paper presented at the symposium and was presented at a 1977 (30 November) symposium of the Entomological Society of America, entitled "Progress in the Implementation of the Endangered Species Act and the Convention of International Trade in Endangered Species of Wild Fauna and Flora."

Contribution no. 417, Bureau of Entomology, Division of Plant Industry, Florida Department of Agriculture and Consumer Services, Gainesville, FL 32602, USA.

Biological Station. It was sponsored by the Florida Audubon Society and the Florida Defenders of the Environment. Florida Governor Askew and Assistant Secretary of the U. S. Department of Interior, Nathaniel P. Reed, served as Honorary Co-Chairman of the Committee, which was primarily composed of Florida scientists, representing many of the state's universities, private research and educational organizations, and state and federal agencies.

Organization

Later, the Florida Legislature designated to the Florida Game and Fresh Water Fish Commission on the legal responsibility on behalf of the state government to pursue essentially the same objectives as those which had been adopted by the independent committee already functioning. Since this committee encompassed many of the people within Florida and neighboring states with the greatest expertise on the subject and had already made substantial progress toward assembling the basic data needed, the people who comprised the Coordinating Committee of the Florida Committee on Rare and Endangered Plants and Animals were asked to serve as an official (but unpaid) Technical Advisory Committee on Endangered Species for the Florida Game and Fresh Water Fish Commission. This Technical Advisory Committee is a standing committee, with its personnel reappointed annually. It has a continuing responsibility to gather and refine data, to attempt to monitor fluctuating populations of species of special concern, and to continue to serve as an advisory body to the Florida Game and Fresh Water Fish Commission.

The Technical Advisory Committee consists of the chairpersons of the special committees and as many additional members as are necessary to carry out responsibility for over-all planning and direction of the project and to function as the editorial board, in preparation of an inventory for publication. Special Commitees handle specific aspects of the data-gathering process. Most of them represent particular groups of organisms, both plant and animal, and are comprised of specialists in those groups. Individuals who are not members of the Technical Advisory Committee or Special Committees or agencies and organizations participating in the program are designated Cooperators.

Objectives

The primary objectives of the Committee are to (1) prepare a comprehensive inventory of rare and endangered plants and animals in Florida, (2) draw up recommendations and guidelines to aid in preserving threatened populations, (3) encourage further research on rare and endangered forms in the state in order to provide data that will help to devise strategies to aid their survival, (4) promote greater public understanding of the special significance of rare and endangered plants and animals as well as the values and importance of all wildlife, and (5) develop an annotated list of endangered habitats in Florida, including ratings of urgency for action to be taken for their preservation.

The inventory of rare and endangered forms includes both inconspicuous and little known native plants and animals, as well as the more spectacular and familiar wildlife species. It attempts to bring together all available information on the population status of these forms, together with relevant data on their distribution, ecology, and life history in the state. The report also seeks to identify those regions and habitats in the state that are of critical importance for protection of rare and endangered forms; this is an aid to various governmental agencies and other organizations concerned with land-use planning and preservation of natural resources.

Taxonomic Coverage

The inventory includes species, subspecies, and local populations of particular scientific, aesthetic, or environmental significance. All major groups of plants and invertebrate and vertebrate animals are covered, with the realization that the data for some groups such as insects or marine invertebrates will be far less complete than for groups such as birds or mammals.

I have served, and continue to serve, as the Chairman of the Special Committee on Insects and Other Arthropods, excluding Marine and Fresh Water Crustacea. The scope of this committee also includes terrestrial mollusks, such as tree snails.

Status Categories

For the purposes of the Florida list, the status of taxa with ranges extending outside the state is evaluated on the basis of the Florida population. Thus, a taxon which might be abundant elsewhere but whose existence in Florida is threatened will appear on the list under the category which best reflects its status in Florida. The categories used to designate the status of forms included in the Inventory of Rare and Endangered Plants and Animals of Florida are as follows:

Endangered. Taxa in imminent danger of extinction or extirpation and whose survival is unlikely if the causal factors presently at work, continue. Their numbers have been reduced to such a critically low level or whose habitat has been so drastically reduced to degraded, that immediate action is required to prevent their loss.

Threatened. ("Vulnerable" in the International Union for the Conservation of Nature and Natural Resources list). Taxa believed likely to enter the endangered category in the near future if the causal factors now at work continue to operate. Included are taxa in which most or all populations are *decreasing* because of over-exploitation, massive depletion of habitat, or other environmental disturbance; taxa whose populations have been *heavily depleted* by adverse factors and the ultimate security of which is not yet assured; also taxa which may still be abundant but are *under threat* from serious adverse factors throughout their range in the state.

Rare. Taxa with small populations in the state which, though not presently endangered or threatened, are potentially at risk. Taxa localized within a restricted geographical region or habitat or thinly scattered over a more extensive range are included. They may be insular or otherwise isolated forms or relict forms with wide distribution. They also may be forms that are seldom recorded and which may be more common than supposed, although there is reasonably good evidence that their numbers are low.

Species of Special Concern. Species not clearly fitting into the Endangered, Threatened, or Rare categories, yet still warrant

special attention. A good example is the American Alligator (*Alligator mississippiensis* (Daudin)). Present knowledge of this species in Florida indicates that it has increased in suitable habitats and can no longer be objectively regarded as endangered, threatened, or rare. However, relaxation of protection of this species in any way that would directly or indirectly stimulate commercial traffic in crocodilian hides of any species in any part of the world would be potentially detrimental to other crocodilian species, such as the American Crocodile (*Crocodylus acutus* Cuvier), whose status is presently critical.

Status Undetermined. Taxa that probably fall into one of the preceding categories, but for which data are insufficient to provide the basis for a decision.

Recently Extinct. Species or subspecies that have disappeared from the state through extinction in historic times (since 1600).

Recently Extirpated. Taxa that have disappeared from Florida since 1600 but are still extant elsewhere. The Bahaman Swallowtail (*Papilio andraemon bonhotei* Sharpe) and the Atala Butterfly (*Eumaeus atala florida* (Roeber)) (Fig. 1), are examples.

Figure 1: Female (left) and male of the Atala Butterfly (*Eumaeus atala florida*).

Dissemination of Results

The work of the Committee is to be published as a comprehensive report which contains accounts of each of those organisms included in the inventory. Additional sections are included, dealing with the general significance of rare and endangered forms, an overview of the geographic and ecological distribution of rare and endangered plants and animals in Florida and factors threatening their populations, descriptions and distribution of major terrestrial and aquatic habitat types in the state, and recommendations for the preservation of the state's threatened biota.

In selecting a format for the report, attention is being given to a design that will facilitate updating of information and ease of locating specific data.

Individual accounts of species, subspecies, or unique local populations included in the list will follow a standard format, containing, where available, the following information in succinct form:

Status: Endangered, Threatened, Rare, Species of Special Concern, Status Undetermined, etc.

Common and Scientific Names: All parts of each scientific name will be included, with the name of the describer or describers.

Classification: Normally the order and family will be given, although other or additional taxonomic categories may be advisable in some groups.

Other Names: Other widely used common names for the taxon and any important synonyms of its scientific name will be listed.

Description: A brief non-technical general description of the organism, including size, to aid a reader not familiar with the group to visualize its appearance. Also prominent sex and age difference and characters distinguishing it from closely-related forms or other organisms with which it might be confused will be given.

Range: Both the general geographic distribution of taxa whose ranges extend beyond Florida and as detailed information as possible on the range within the state will be included. The time period to which distributional data apply and any major changes in the Florida range that have occurred in the past or are taking place today will be given, if applicable. Also to be included are type localities of species or subspecies described from Florida and, if known, the present status of the form in terms of drainage systems, where relevant. Standard outline maps will be used to show the Florida range of each taxon; for those forms with ranges extending beyond the state, there will be an additional map showing the overall distribution.

Habitat: Description of Florida habitats where the taxon occurs, indicating, where applicable, which habitats are primary or preferred and which are of secondary importance. Indication of which environmental factors appear to determine its habitat orientation. When possible, the location of especially favorable habitat conditions within the state will be given.

Life History and Ecology: Salient features of the life history and ecology of the taxon will be given, with emphasis on those aspects, such as home range size, dispersal tendencies, reproductive rates, and population dynamics that are relevant to understanding its habitat relationships, population status, and geographic distribution.

Specialized or Unique Characteristics: Any features of the taxon that give it special scientific, aesthetic, or economic significance.

Basis of Status Classification: A summary will be presented on past and present population levels destruction of habitats, and other evidence used as the basis for assigning the taxon to the given status category and discussion of possible future changes in status based upon present conditions and trends.

Recommendations: Notation of any steps already taken to protect the form in Florida and provision of additional suggestions of measures such as establishment of sanctuaries, protection from hunting, etc. to aid in its preservation

and recommendations for specific types of research needed to gain a better understanding of its status or critical features of its biology may be given.

Acknowledgments.

Selected References: Important published or unpublished works on the taxon will be given. Personal communications may be noted in the text but not in references.

Name of Author and Institutional Affiliation.

Illustrations: A photograph or drawing of the subject plant or animal and additional photographs of typical habitats or characteristic features of its life history or ecology will be used.

There are several difficulties which confront one in any attempt to survey for a particular invertebrate species, problems that usually do not concern one gathering information on vertebrate animals. These difficulties are: (1) The immense number of species to be dealt with; (2) The comparatively small size of most invertebrates; (3) The seasonal occurrence of the adult or other readily identifiable life history stage; (4) The lack of available data for many species, due partly to inadequate survey, which in turn, is primarily a result of inadequate funding for invertebrate surveys in comparison to vertebrate studies; and (5) The difficulty of identification, stemming from the lack of competent taxonomic specialists in some groups, and underpaid, overworked specialists in others.

There are groups of insects and other invertebrates which are not being worked on, have not been worked on for many years, or have never been worked on in Florida. There is a great need for long-range surveys of Florida arthropods, just to establish what is there. In addition, a tremendous amount of investigation is needed to acquire more detailed information about each species.

The current list of threatened and endangered Florida invertebrate species is admittedly much biased, due to factors already mentioned. Most species for which data can be obtained with a high degree of confidence are restricted to those groups which can be located and identified by sound (such as certain Orthoptera), and/or those which occur only in special habitats, such as (1) the fast-disappearing tropical hardwood hammocks of southern Florida; (2) caves; (3) water systems (which themselves are becoming endangered); (4) on plant or animal hosts which are themselves endangered or threatened and to which these invertebrates are restricted (including food hosts and hosts of endo- and ectoparasites); (5) unique land habitats such as fossil sand dunes; and (6) rare and unique microhabitats, such as pack rat nests, which harbor fauna of small animal species often found nowhere else.

I believe I am safe in saying that most invertebrate specialists who are well informed on the subject agree that increased awareness by the general public of the need to take concrete actions toward the preservation of threatened and endangered species of plants and animals, including even the inconspicuous and supposedly non-economic species of invertebrate animals, is very important. However, it is also important that efforts to protect these endangered or threatened species not be hampered by restrictions on collecting by properly qualified researchers. Such restrictions may prevent or seriously handicap the continuing effort by competent researchers to obtain basic information concerning species about which we know all too little, and they may even pinpoint the truly rare species for unscrupulous collectors.

The answer to invertebrate species protection lies primarily in the preservation of adequate habitat samples sufficiently large to allow the preservation of rare species. Systematists should be among the most sensitive to this issue, for the accelerating reduction in the number of species on our planet is one of the fundamental issues of our time. Systematists, with their intimate knowledge of biological diversity, are in a unique position to convey that sense of wonder for our natural world, and they form a major part of the tiny band capable of doing so. The time may not be far off when conservationists, backed to the wall, will need to seek advice from systematists as to which species to "write off," and which to fight harder for. It should be noted that while legislative approaches and habitat preservation often are the conservationists' main manner of action, in the end it is often the single, spectacular species that "sells" a particular conservation project, and in the process permits the preservation of associated and similarly threatened species of less concern to the general public.

Money is now available to permit the Florida Game and Fresh Water Fish Commission to publish the findings of its Technical Advisory Committee on Endangered Species, a more comprehensive report than anything published to date by any other state. A coordinator has been appointed by the Commission to ramrod publication of the report, which is to appear in several sections beginning with the reports on the vertebrate groups: mammals, birds, reptiles, amphibians, and fishes. To follow will be the reports on plants and invertebrates. There will be a summary volume at the end.

The style of these bulletins will follow fairly closely that of the irregularly appearing bulletin series titled *Arthropods of Florida and Neighboring Land Area*, published by The Florida Department of Agriculture and Consumer Services.

We expect bids for printing of the first sections to be taken within three to six months and one or more sections to appear in print within six to nine months.

Because of federal subsidy of some parts of the report, notably some of the art work, the report will be available to the public without charge.

One major problem remains to be solved. At present, Florida state laws provide only general protection for designated vertebrate animals, with enforceable penalties for transgressors. What is badly needed is adoption of laws providing for comparable protection of designated invertebrate animals and plants. Efforts are underway to bring this about, but progress has been slow to date. In this connection, it is important that the original Florida Committee on Rare and Endangered Plants and Animals (FCREPA) continues to function as an independent advisory committee, in contrast to the role of the Florida Game and Fresh Water Fish Commission's Technical Advisory Committee on Endangered Species; this is so that biological experts, functioning as FCREPA, can make recommendations and take actions, including those that might be in conflict with the official position of the Florida Game and Fresh Water Fish Commission.

Endangered Habitats for Insects: California Coastal Sand Dunes*

Jerry A. Powell

Division of Entomology and Parasitology, Department of Entomology, University of California, Berkeley, California 94720, USA

Abstract

Coastal sand dunes of California represent natural habitats which support unique plant and insect communities and occur in such limited geographic areas that destruction of whole populations is likely. Habitat alteration/destruction comes from the invasion of agressive non-native plants, urban and industrial growth, and off-road vehicle (ORV) use. A brief review of the status of three dune systems of special interest: Antioch, San Francisco and Santa Maria is made.

Eighteen of the 32 identified coastal dune systems in the state were surveyed for microlepidoptera. The results seem to indicate higher species diversity in larger dune systems, although several problems exist in interpreting these data. On the basis of distribution, three general groupings of species can be made. Only a few of the surveyed species represent narrow endemics, restricted to one or two adjacent dune systems.

Introduction

The preceding contributors have discussed political and theoretical aspects of extinction and the endangered species problem. Examples of conservation programs in progress, including management projects, have been given. In contrast, my topic is the description of a natural habitat that supports unique plant and insect communities and occurs in such limited geographical areas that destruction of whole populations is likely. The coastal sand dune systems of California provide a relevant example since in the western United States we have the dilemma of an incomplete knowledge of insect fauna, coupled with continued population growth and the associated decimation of habitats.

I know of no documented cases where widespread species of North American insects are being uniformly eliminated by the effects of man, as is the case with predatory mammals and birds. In general insects can persist in smaller areas, can tolerate higher levels of foreign substances such as insecticides, and are lower on the food chain. Insofar as insects are concerned, "endangered" refers to local situations where populations are confined to naturally subscribed habitats. It is the destruction of these habitats with which we are concerned.

The only difference between the extinction of a local population and of a species is one of degree. Whether local populations are or were potentially interbreeding with other similar populations is a matter of conjecture; the degree and duration of isolation indicated by slight morphological distinctions exhibited in insects considered to be locally occurring species, such as in the extinct San Francisco butterfly *Glaucopsyche xerces* (Bdv.), are unknown. Indeed, the degree of isolation is not important; rather it is the elimination of communities which unique insects represent that is the central issue.

Preservation of habitats, not species, will have to be the aim of any conservation efforts directed to insects, and Lepidoptera may play a key role since butterflies are so much better known than other insects. In the United States, most conservation proponents have focused their attention on vertebrates or dominant plants as indicator species simply because invertebrates are too poorly known to document the plight of diminishing habitats. Yet in local situations like coastal dunes, a given site may have no endemic vertebrate colony and an insect population could play an important role in conservation.

Characteristics of Coastal Dune Communities

The coastal dune community develops wherever there is accumulated sand above high tide level, and it occurs like a chain of islands along the immediate ocean front of the Pacific Coast of North America. The active foredunes and inner, stabilized dunes support a simple, yet unique plant and animal community. The overall diversity is low, with only a few dominant plant species at any given locality, and there is a little horizontal zonation in the vegetation. In California these areas are characterized by annual rainfall ranging from 175 cm in the north to less than 30 cm in the south. There is considerable fog and wind, particularly during summer, which is the dry season for other low elevation communities in the region. The growing season is 12 months, with 360-365 frost-free days. The climate is thus moderate with small seasonal and diel fluctuations in temperature; the summer maxima range 16-22 degrees C and the minima in winter 4-8 degrees C.

The vegetation is low or prostrate, often succulent and late flowering relative to nearby communities. There are three primary zones or land forms, although not all occur at each locality: (1) The *foredunes*, the line of dunes paralleling the beach behind high tide level. These are characterized by unstabilized sand, partially covered with a simple community of 3 to 6 low-growing invader plant species; (2) The *deflation plain* immediately back of the foredunes, which is at or near the water table, and is characterized by a mixture of water tolerant plants and invader dune species; (3) The inner zone consisting of

*Based on a presentation in the symposium "Endangered Insects of the World," 21 August 1976, at the International Congress of Entomology, Washington, D.C. Some aspects of the data presented here, however, are the result of research during 1977.

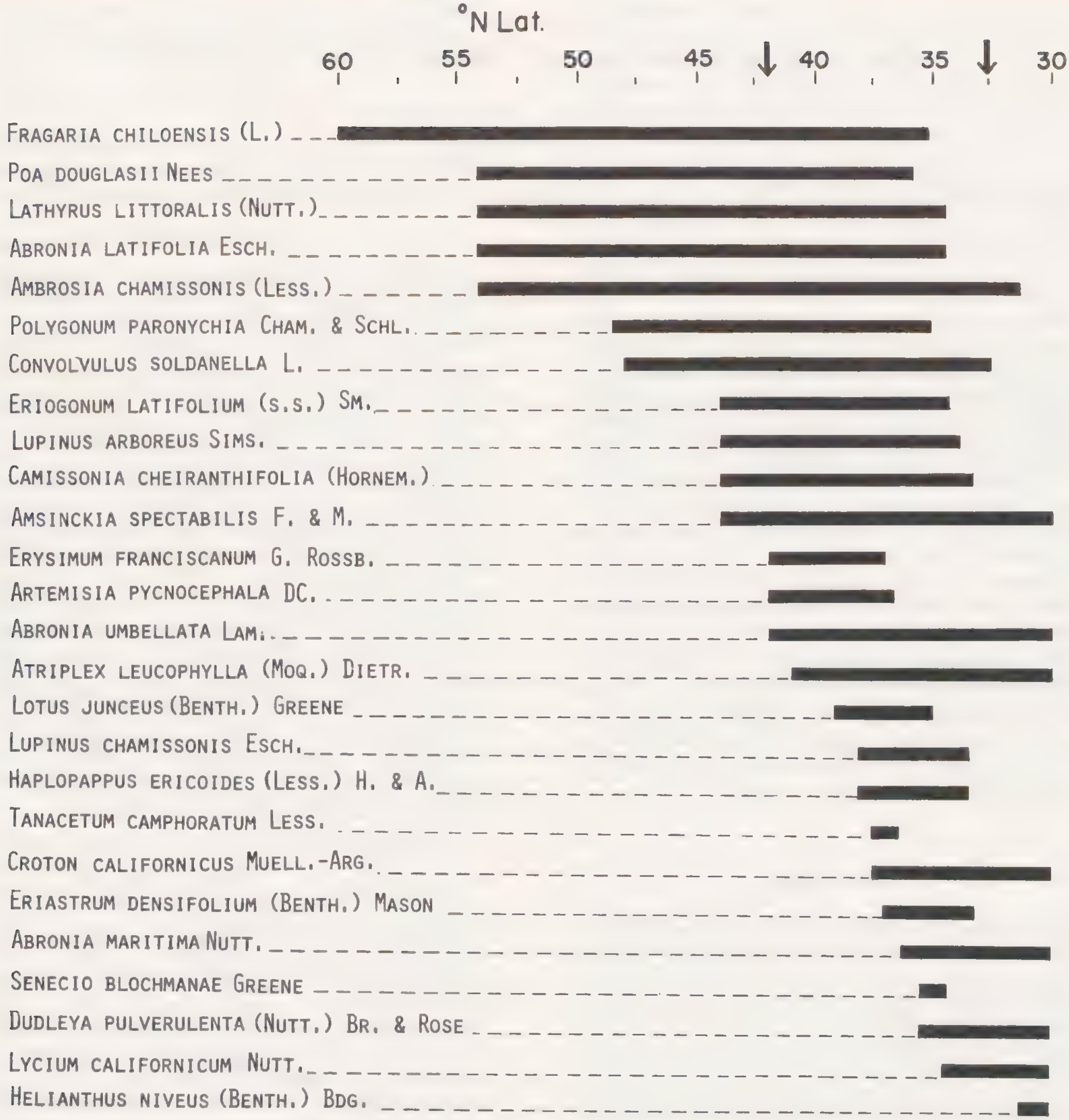

Figure 1: Latitudinal distribution of 26 characteristic coastal dune plants. Arrows indicate northern and southern boundaries of California.

stabilized dunes, situated adjacent to the deflation plain or in large dune systems still farther inland, behind high dunes of open active sand. The stabilized dunes, which are dominated by woody perennial plants, may be dissected by parabolas of secondarily invading, unstabilized sand.

The characteristic unstabilized foredune habitat occurs at even the smallest coastal dune areas. Invader plant species include *Cakile maritima* Scop., *Eriogonum latifolium* Sm., *Abronia maritima* Nutt., *A. latifolia* Esch., and *Ambrosia (Franseria) chamissonis* (Less.) Greene. There are interspersed areas of active sand, and the association supports a rich insect community of phytophagous species and sand-burrowing scavengers and predators and their associates. The unstabilized habitat gives way, often abruptly, to stabilized dunes, characterized in northern California and northward by conifers and shrubs such as *Arctostaphylos* sp. and *Vaccinium* spp. In central and southern California the stabilized flora consists of a chaparral dominated by summer- and fall-blooming woody shrubs such as *Haplopappus ericoides* (Less.) H. & A., *Eriogonum parvifolium* Sm., and *Baccharis pilularis* DC.

Despite superficial uniformity of this community, the species constitution varies considerably from north to south. Some species extend the length of the state and beyond, but others reach their distributional limits in either northern, central, or southern California. The plant community therefore gradually changes in species composition and in formation from a more mesic one in the north to a less diverse, more xeric one in the south. As a result, most phytophagous insect species do not occur throughout the coastal strand even within California. Fig. 1 illustrates latitudinal distribution of some of the most characteristic plant species of the Pacific Coastal dunes (data from Munz & Keck, 1959, 1968; Breckon & Barbour, 1974). The 26 plants are listed in descending order of their northernmost occurrence. Species range differently in terms of latitude, with northern species tending to be more widespread. Within the shift in flora, the greatest diversity occurs in central California, with 13-15 species in northern California communities, 20-22 in the central coast and only 8-10 in the more xeric, southern California dune system.

Effects of Human Population

The coastal strand and sand dune communities in general have survived a curious paradox in their relationship with humans. During early colonization in the 18th and 19th centuries in California, the dune systems were largely spared because they were undesirable for man's activities, especially agriculture. Thus, in most cases these habitats survived until they could be partially sampled by biologists (unlike certain communities such as natural grasslands, which were essentially gone before entomologists arrived on the scene). With accelerating population pressure in recent decades, however, the dune communities are being eliminated because they are considered wasteland of no practical value.

There are three primary kinds of decimation of dune habitats by man: (1) The extensive planting of alien plants for stabilization, especially Iceplant (*Mesembryanthemum* spp.) from South Africa and the European Marram Grass (*Ammophila arenaria* (L.) Link.). The latter outcompetes native floral elements and forms dense stands that are essentially devoid of insect life (Slobodchikoff & Doven, 1977). (2) Urban and industrial growth, including sand mining, where dune systems occur near metropolitan centers. (3) The recent, amazing popularity of off-road-vehicles (ORV), which has accelerated destruction of the fragile plant communities far beyond that of urban sprawl itself. Thus there are complicating factors in conservation of these habitats.

Fig. 2 depicts the distribution, size, and estimated condition of one riverine and 32 coastal dune systems in California (data mainly from Cooper, 1967, and personal observations 1974-1977). Each dune system is indicated in black (somewhat exaggerated in extent). The circles refer to relative size, computed by multiplying the greatest straight line length by the width of the unstabilized and stabilized portions of each dune system. This can be interpreted as an estimate of biological island size, not actual area. The black portion of the circular pie diagrams are estimates of the percent area that has been destroyed by human activities. The shaded areas are estimates of the proportion of the remainder that is held in some kind of "preserve" (state, county, University of California, etc.; designations of ownership indicated in the legend). About 75 percent of the systems are small, less than 10 square kilometers, and these include primarily unstabilized foredune habitat. In fact, about half of these are less than 2 square kilometers. Essentially all the southern California dune systems are destroyed, although fragments of the once extensive El Segundo dunes are held in preserves by Standard Oil Company and the City of Los Angeles.

Of special interest are the five largest systems. San Francisco and Los Angeles (El Segundo) are essentially gone, while the three in less populous, central California are the best large islands remaining: Monterey Bay and the vicinity of Purisima Point (both largely military) and the Santa Maria dunes system (state and private).

Status of Insect Survey

Sporadic collections of insects were made at coastal dune localities during the first half of this century [e.g. 1905-1920 at San Francisco; concerted survey efforts by Pierce and others at El Segundo in the late 1930's (Pierce & Pool, 1938 *et seq.*)], but no really systematic survey of any dune system in its pristine condition ever occurred. My special interest is in the microlepidoptera (small moths), although I carry out general insect survey during field work. I began studying coastal sand dune insects in the late 1950's in connection with a moth, *Argyrotaenia franciscana* (Walsingham, 1879), the first microlepidoptera described from the California coastal dunes (Powell, 1960, 1964, 1965). I continued sporadic sampling through the 1960's, and in 1972 began a more systematic survey of coastal dunes after I recognized the drastic effects of off-road vehicles (ORV's) on the Santa Maria dunes, our largest dune system. I have probably sampled this habitat more than any other entomologist and therefore am in the best position to appreciate the inadequacy of our knowledge.

Of the 32 dune systems (Fig. 2), 18 have been surveyed for microlepidoptera at least once. All the others are small, less than 10 square kilometers, except one, Purisima Point (now largely Vandenberg Air Force Base). However, not a single system has been sampled around the calendar and clock in a systematic fashion. This statement is probably true for all dune insects. One exception may be the sand-dwelling Coleoptera, which have been sampled for diversity, abundance, and seasonal succession at several dunes in California by J. T. Doyen of the University of California at Berkeley.

Distribution of Coastal Dunes Microlepidoptera

When studying microlepidoptera and other plant-feeding insects, there are three primary sources of problems in any attempt to assess endemism or other aspects of geographical distribution. First, definition of the habitat is difficult because many plants do not observe dune boundaries. At each locality, plant species characteristic of adjacent non-dune habitats also inhabit stabilized or even unstabilized dunes. Ideally we would need to know the host plant preferences of each insect in order to judge which are limited in occurrence to the dune community. Second, we have inconsistent sampling, both seasonal and geographical. For example, my surveys have ranged from 1 to 30 days per locality. Larger dune systems have received more attention, which of course is necessary to attempt coverage of the greater diversity of habitats. As might be predicted by island biogeography theory, the larger dune systems have more insect species, but to what extent the data reflect community

Figure 2: Distribution, size, ownerships, and estimated condition of one riverine and 32 coastal dune systems in California. Line on left page traces coast from Oregon border to Monterey Bay, on right page, from Monterey Bay to the Mexican border. Pie diagrams indicate estimated proportions destroyed by effects of man (black portion) and proportion held in some kind of preserve (shaded portion). Remaining portions (white) are relatively undisturbed and are unprotected.


P = PRIVATE ; C = CITY, COUNTY ; S = STATE ;
F = FEDERAL ; NC = NATURE CONSERVANCY ;
UC = UNIVERSITY OF CALIFORNIA
300 - 400 KM2
100 - 200 KM2
25 - 80 KM2
10 KM2
P
P, S
P, C, S, F, NC
P, F
S
P, S
P
P, S, UC
P
P, F
P
P, C, S, F
P, C, S
P, S

size and to what extent they reflect sampling effort is unknown. The third source of problems lies in the state of taxonomic knowledge of insects. Reliable identifications can be obtained in some families of small moths but not others, and often in this discussion "recognized" species does not mean named species. The survey to date has revealed about 200 species of microlepidoptera including the pyraloid moths, but the taxonomic status is uncertain for 30 or 40 others. It is not known whether these are the same species as similar looking moths at other localities. Even so there are some preliminary generalizations concerning the fauna that can be surmised from available data.

Table 1 indicates the total number of microlepidoptera species recorded from each of 18 dune systems, the dune system areas, and the number of sampling days at each locality. Owing to discrepancies in the seasonal distribution of sampling days and the low number of sampling days in southern California these figures cannot be compared statistically. However, disregarding localities only sampled once or twice, we have an indication that the largest dune systems have the most complex communities of these moths.

In Fig. 3, species associated with non-dune plants are omitted, and three basic components of the distribution pattern are evident among the 101 remaining species: (1) Northern species, those extending from Oregon or beyond southward into California. Among species which are adequately surveyed, some extend to Mendocino County, others through the central portion to Monterey, and still others as far south as Point Conception. (2) A southern group which extends into coastal southern California or the Channel Islands from the coast of Baja California or from the desert region. This makes up the largest portion, with many known only from the Santa Maria dune system in my samples. (3) Endemic species, those restricted to the central part of California's coast. As indicated in Figure 3A, 19 species range from Sonoma County south to either Monterey or the San Luis Obispo County dune systems, while another 17 (Fig. 3B) are known from only one or two locations.

The northern group comprises about 21 percent, the southern group 38 percent, and the California endemics about 35 percent of these moth species. Possible narrow endemics, those restricted to one or two adjacent dune systems, are indicated in Fig. 3B. Careful survey will probably reveal several of these to be more widespread. Only a few species are so widespread as to exceed portions of all three distributional groups, making up about 6 percent of the non-dune plant associates.

Figure 3B indicates the possible narrow endemics among the microlepidoptera. Of those for which adequate samples appear to be available, only a few have been documented as narrowly endemic. These include one at San Francisco, one at the Monterey dune system, one at the Santa Maria dune system, and another three or four which occur both at the Santa Maria dune system and Morro Bay. Two species described from the El Segundo sand dunes in Los Angeles have never been collected elsewhere, but the condition of habitats and their survey are poor in this area of the state. Two species appear to be restricted to the Monterey and San Luis Obispo dune systems. Table 2 compares some examples of endemic insects in other orders, most of which also occur on several adjacent dune systems.

Status of Selected Major Dune Systems

The following briefly reviews the status of three localities of special interest: (1) Antioch, the only major riverine dune system in California; (2) San Francisco, both of which have been nearly eliminated by urban and industrial development; and (3) the Santa Maria dune system, which has the largest pristine areas of coastal dunes remaining in California.

Antioch. The Antioch sand dunes comprised a unique ecological area from several standpoints. Although largely decimated by industrialization and sand mining, remnants worthy of consideration for preservation still exist. Biologically the place was a kind of "island" that contained the northern extension of many plants and animals of desert affinities--a biogeographic element that probably extended along the western margin of the Central Valley in prehistoric times. Later, natural processes reduced this biota to a few small areas, of which the largest and most northern sand dunes community was at Antioch. Fig. 4 is redrawn from a 1953 United States Geological Survey topographical sheet, giving an indication of the extent of the dunes. They ranged to 20 meters in elevation and extended 3-4 kilometers along the south shore of the San Joaquin River. Because this site is near Berkeley, it became the best known of the localities harboring desert elements in the Central Valley. Although the dunes resembled coastal dunes in general aspects, such as genera of some of the plants, species of plants and animals are quite different. Most of them are desert species with only a few that also occur in the Pacific coastal beach dunes (compare Table 3, Fig. 1). The long isolation from relatives in the Mojave resulted in considerable local differentiation, or endemism.

This place was discovered entomologically in 1932, and considerable effort was expended in discovery and study of the insect fauna during the subsequent decade and for several years after World War II. Large-scale industrialization around 1952-1954 and subsequent sand mining have greatly reduced the available areas of native community. The overlay of dotted lines in Fig. 4 is based on a 1968 revision of the topographical sheet, and gives an indication of the extent to which industrialization eliminated the habitat.

Although several of the plants appear to be unique ecological types of their species and at least two of these were named, evidently no systematic floral list was compiled during the pre-industrial period. During my field work in 1976-1977, about 40 species of conspicuous plants were observed in the flora, of which 15 are the principal components of the sand dune, desert-interior valley community (Table 3). Antioch represents the northern limit of these elements, and they form the basis of the sand dune insect community.

Although I have not seen photographs of the area in its pristine condition, a 1952 aerial photograph shows the habitat generally to be a stabilized dune community with scattered Coast Live Oak (*Quercus agrifolia* Nee) and relatively little open sand. A *Life* magazine article (issue of 8 September 1955), "The world of the insects," contained a six-page section entitled "Communal life on the dunes" that described interrelationships of the plant and animal community at Antioch, primarily through paintings of Walter Linsenmaier. This was reprinted in the Life Nature Library book, *The Land and Wildlife of North America* (Farb, 1964: 44-49). Thus the habitat and its insects received national attention, although no protection.

Figure 3: Distribution of Coastal dune and strand Microlepidoptera (species associated with non-dune plants excluded). A. number of species recorded by geographical component: northern (21), central (19), and southern (38). B. occurrence of possible narrowly endemic species. Further survey probably will show several of these to be more widespread. An additional 7 species extend the length of California and beyond.

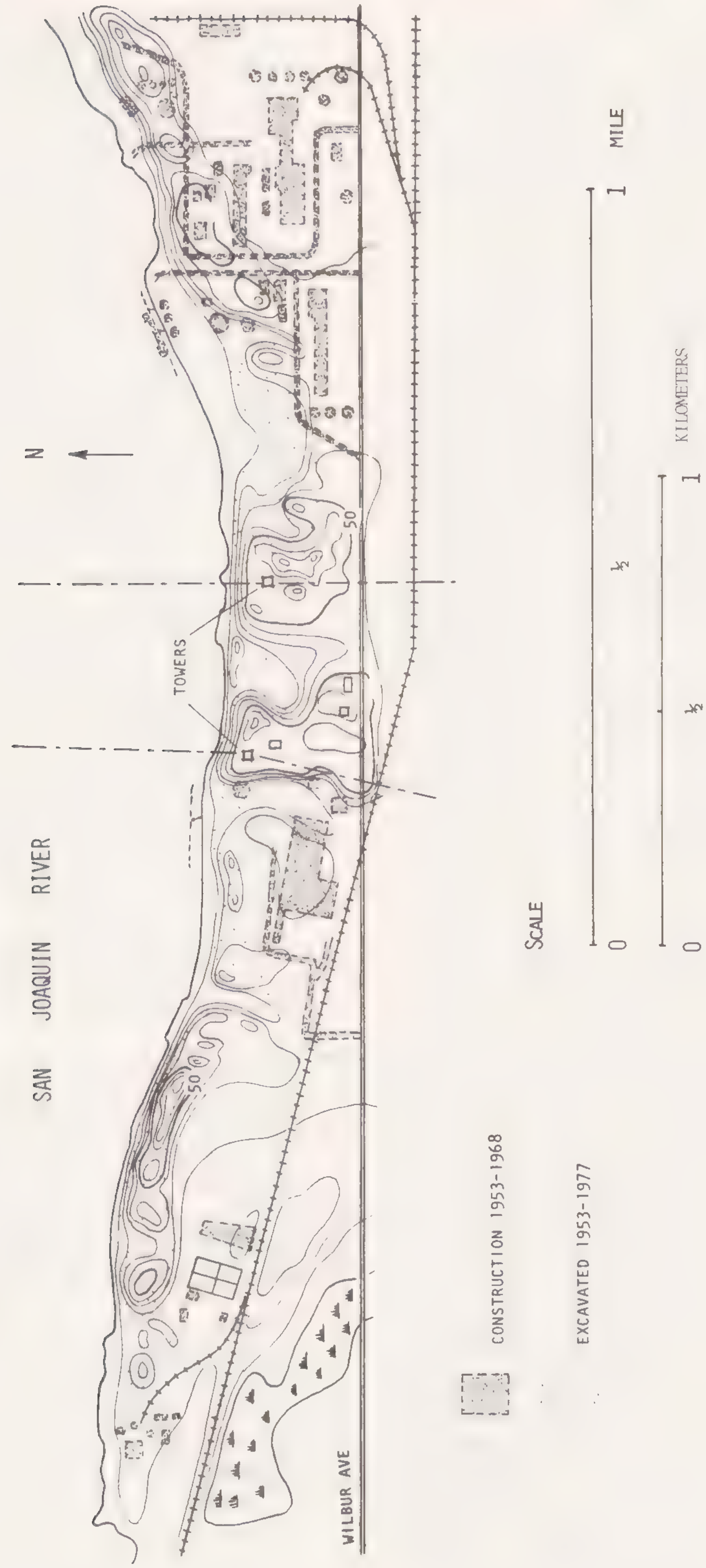

Figure 4: Map of Antioch sand dunes area (left edge is approximately coincident with eastern city limits of Antioch, Contra Costa County, California). Drawn from Antioch North Quadrangle, 7.5. minute series, United States Geological Survey topographic map, 1953. Contour interval ten feet, topography by plane-table surveys in 1906-1907 and from aerial photographs taken in 1949. Overlay delineated by dotted lines indicates construction, 1953-1968, compiled from aerial photographs taken 1968. Sparsely dotted areas depict sand-mining excavations during 1953-1977 in addition to areas leveled for construction of roads and buildings. The two parcels occupied by Pacific Gas & Electric Co. towers are the only unexcavated hills remaining.

One noteworthy aspect of Antioch to entomologists is the extraordinarily large number of insects that have been originally described from there. Zoological literature is not organized in such a way that information by locality can be easily retrieved, but there are at least 25 species or subspecies that have Antioch as the type locality (Table 4). This means it will remain of considerable interest to insect taxonomists and biologists to be able to study populations or specimen samples from Antioch. Among these 25, 11 appear never to have been discovered elsewhere, and another seven are known only from likewise endangered places in the delta or riverine situations of the Central Valley. Moreover, other insects originally described from sandy habitats in the Central Valley in pre-agriculture days may exist only at Antioch now. For example, the last known occurrence of the giant flower-loving fly (*Rhaphiomydes trochilus* (Coq.)) (type locality: Merced), was at Antioch in 1974.

As noted in Table 4, several of the species described from Antioch are not known to have been observed there since the industrial build-up in the 1940's and early 1950's. Although this may in part be due to lack of adequate survey, or to lag in identification of cryptic species in museums, it seems certain that a few, including the Shield-backed Cricket, *Neduba extincta* Rentz, and the beetles *Coelus gracilis* Blasidell and *Anthicus antiochensis* Werner are extinct there now. In addition, it is obvious that some widespread species of arid regions to the south have not survived at Antioch. Several larger flies and wasps of desert affinities which were common there in the 1930's and 1940's have not been collected there since 1954-1958. Survey during 1976-1977 indicated that there has been a general decline in species diversity in some families with sand dune-based biologies, such as robber flies (Asilidae), stilleto flies (Therevidae), and velvet ants (Multillidae). In other groups, such as spider wasps (Pompilidae) and bee flies (Bombyliidae), it appears there are comparable species numbers now, but some are replacement species not known there in pre-industrial days. Further analysis will be necessary to interpret changes in faunal composition.

Among the surviving species is Lange's Metalmark Butterfly (*Apodemia mormo langei* Comstock) (Fig. 5A). This race was described in 1938 and is known only from the Antioch dunes. In 1977 it existed in two colonies, each less than 4.05 hectares (10 acres) in extent. This species feeds in the larval stage only on buckwheat, *Eriogonum nudum auriculatum* (Benth.) Tracy. Thus, it is dependent on the persistence of that plant. The butterfly survives despite extreme drought in 1976-1977, increased rototilling as a fire prevention measure, and a June 1976 fire that destroyed a major portion of one *Eriogonum* colony. During a mark-release study in 1977 (Arnold & Powell, unpublished), we tabulated about 170 individuals in one of the populations during the second half of the flight period. A number of females emigrated eastward with the prevailing wind into the 1976 burn area, and oviposition occurred there.

Negotiations are in progress by the United States Fish and Wildlife Service of The Department of the Interior to obtain ownership of one portion of one of the colonies and management of two adjacent areas owned by Pacific Gas and Electric ("Towers" in Fig. 4). If successful, this would preserve about half the remaining extent of *Eriogonum*. Other major portions of the dune community, including the best remaining fragments of unstable sand, are in private ownership, zoned for industrial use and are unlikely to be preserved.

San Francisco. Another example of destruction of a coastal dune system is that of the San Francisco peninsula, which contained the fourth largest sand dune community on the California coast. Cooper (1972) illustrated the supposed extent of the original dune system, which included most of the western half of the present city of San Francisco, with an eastward extension projecting well into the downtown area. As late as the turn of the century, most of the western area was open dunes. Therefore, many insects were discovered and described from here. Golden Gate Park was developed as a corridor through the center of the sandy "wasteland" during 1870-1920, and the last dunes in western San Francisco were converted to parks in the early 1950's. A few fragments remain, such as at Baker State Beach on the Presidio, Sutro Heights, and Sunset Heights.

Glaucopsyche xerces (Boisduval) (Fig. 5B) is a lycaenid butterfly that lived in the San Francisco sand dunes. It is the only species of North American Lepidoptera that is known to have become extinct in recorded history. It was noted to be on the decline as early as 1920, and the last known specimens were taken in 1943 (Downey & Lange, 1956). The last colony occurred near the Marine Hospital on the Presidio, and construction during World War II is believed to have destroyed that colony. Probably the larvae were host-specific on *Lotus* and *Lupinus* spp. and may have had a symbiotic relationship with ants. Both of these plants survive in relatively undisturbed habitats such as at Baker Beach, (Fig. 5C), but evidently the remaining islands of native community are too small to preserve populations like *G. xerces*.

On the other hand, this locality supports a population of the tortricid moth, *Grapholita edwardsiana* (Kft.) (Fig. 5D). This species was described in 1907 from specimens in the Henry Edwards collection ("Cal.," "S. Fran. Cal.") which are believed to have been collected in the 1880's around San Francisco. *G. edwardsiana* remained an enigma for more than half a century until it was discovered in association with *Lupinus arboreus* Sims. at the Presidio in 1960. Recent studies have shown the larva to be a host-specific stem borer in *L. arboreus*. Because this plant was one of the dominant elements of the sand dunes, the moth was probably widespread. Now, however, we know it only from three colonies: Baker Beach, the south end of Lake Merced, and at the mouth of Colma Canyon in Daly City. The species was listed on a notice of review for possible Threatened status by the Office of Endangered Species of the United States Fish and Wildlife Service.

Many other species were originally described from San Francisco because it was a coastal dune locality easily accessible to collectors in the early days of California. But most of these are known to occur elsewhere, e.g. the Bumblebee Beetle (*Lichnanthe ursina* (LeConte)), and the Pheres Blue Butterfly (*Icaricia icarioides pheres* (Bdv.)), both of which are believed to be extinct at San Francisco but are common at Point Reyes, Marin County.

Santa Maria. Originally the largest coastal dune system in California, extensive portions of the Santa Maria dunes have been destroyed by urban and agricultural growth and recreational use. Even so, the area contains the best undisturbed habitats of both unstabilized and stabilized dunes on the California coast. All of the immediate coastal area is in Pismo Beach State Park, including the highest parts of the dunes (up to 50 meters elevation), a zone some 20 kilometers in length. Much of the stabilized dunes inland are in private ownership.

Figure 5: California Coastal dune insects. A. *Apodemia mormo langei* Comstock (Antioch). B. The extinct lycaenid, *Glaucopsyche xerces* (Boisduval) (San Francisco). C. Relatively undisturbed dune habitat above Baker Beach, San Francisco, in 1976. D. *Grapholita edwardsiana* (Kearfott) (San Francisco). E. *Argyrotaenia franciscana* (Walsingham) (left) and *Argyrotaenia* n. sp. (right) (Oso Flaco Lake). F. *Areniscythris brachypteris* Powell (Dune Lakes). G. *Ablautus schlingeri* Wilcox & Martin (Dune Lakes).

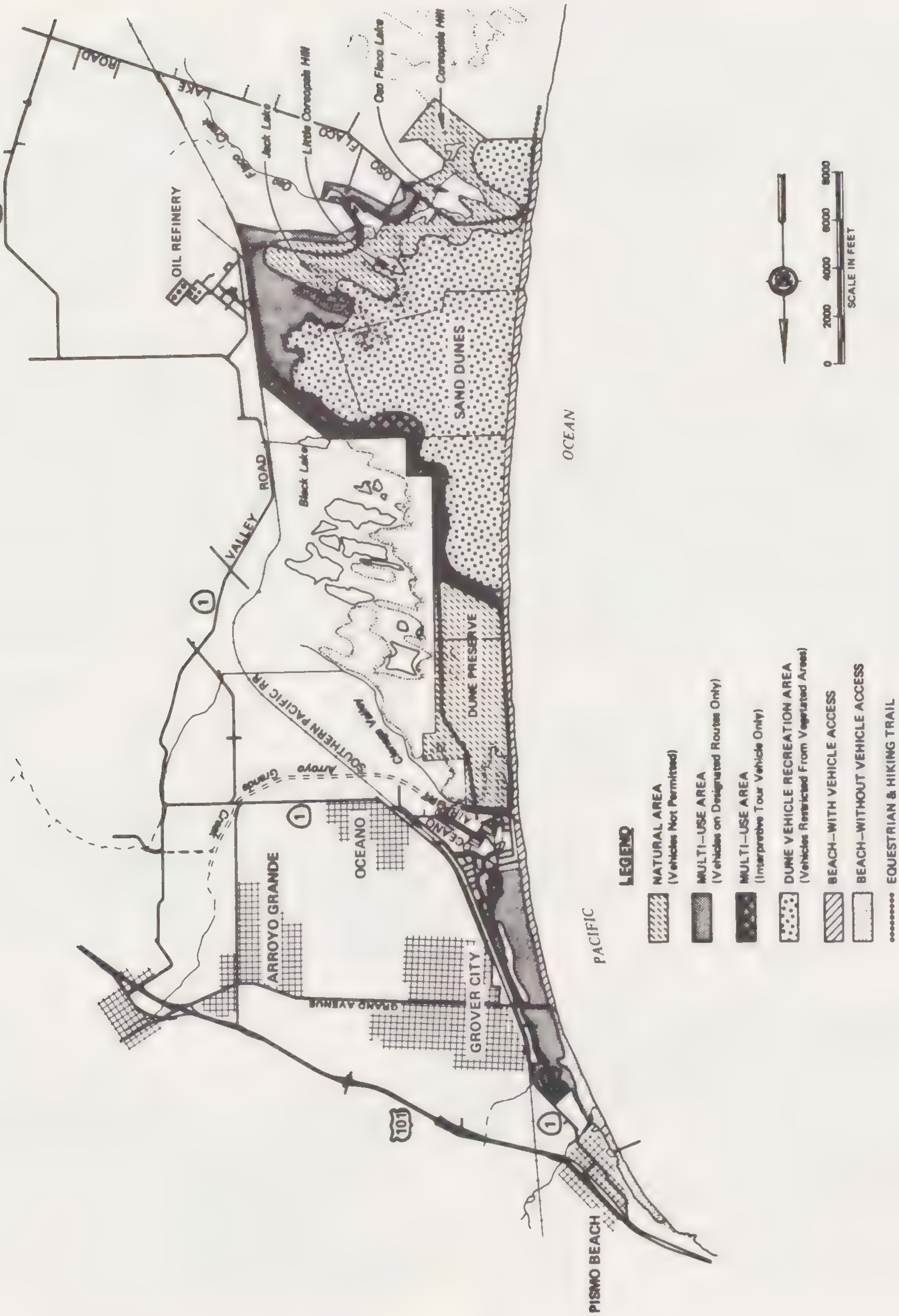

Figure 6: Map of Santa Maria dunes, San Luis Obispo County, including Pismo State Beach, Pismo Dunes State Vehicular Recreation area, and adjacent lands (private ownership). Map prepared by the California Department of Parks and Recreation; Land use plan indicated on legend (See Fig. 7 for effects of recreational vehicular use of land adjacent to Oso Flaco Lake, here designated as "Natural Area, vehicles not permitted").

A rich flora occurs here, including both northern and southern, more desert-like elements such as *Abronia umbellata* Lam. and *Croton californicus* Muell.-Arg., as well as many insects that do not range north to the San Francisco Bay. This area includes the largest number of endemic coastal strand plants in California, with about 10 species and races known only from here and the Morro Bay area (Stebbins & Major, 1965; Hoover, 1970). In contrast to most insect species, which are known from a series of coastal dunes (Table 2), several insects are known to be endemic to the Santa Maria system. The most remarkable of these is the recently described *Areniscythris brachypteris* (Fig. 5F, cover illustration), a flightless, jumping moth that buries itself at night. This is the only known continental Lepidopteran in the world that is flightless in both sexes (Powell, 1976). Among other endemic insects here are the small robber fly (*Ablautus schlingeri* Wil. & Mart.) (Fig. 5G), whose relatives live in the deserts, and the grasshopper (*Trimeritropis pogonata* Stroh.) the sand-colored nymphs of which burrow into the loose sand.

Unfortunately, these unique insects must share the habitat with creatures which buzz about the dunes in a much less restricted fashion (Fig. 7B). Off-road-vehicles constantly course over the open dunes, opening ever-widening sand roads through stabilized flora. Pismo Beach State Park encourages ORV activity, providing a map of designated areas (Fig. 6). The so-called "natural areas" include The Oso Flaco Lake area, a county park which has become a center for ORV activity during the past decade. Although many ORV enthusiasts insist that vehicle activity does not affect the flora and fauna, compare Figs. 7A-B, 7C-E-G, and 7D-F-H, which give some indication of the effect of vehicles on stabilized flora in coastal dunes. The pictures are of the same area in the vicinity of Oso Flaco Lake from 1965-1977.

Owing to problems in restricting ORV activity, the best hope for preservation of dune habitats in the Santa Maria dune system now lies in lands that are in private ownership. The unstabilized sand areas are so extensive that excellent, nearly pristine areas of stabilized and unstabilized dune flora lie well inland, a kilometer or more from the ocean, outside the state park lands.

Conclusions

Preservation of coastal dune and strand areas in California is occurring through various agencies: federal and state government, University of California, Nature Conservancy, and others. However, most of the preserves are small and involve only foredune, unstabilized habitats. Ideally, preservation requires designation of parcels of land of sufficient size to support all elements of the community, yet we have little data to establish minimum sizes of "islands" necessary to support arthropod communities over long periods of time. Habitats preserved through state agencies or otherwise and designated for multiple use may not act as preserves for many of the community members when ORV activity is permitted. If it is prohibited, active guarding may be necessary with patrolling and/or heavy duty fencing because ORV enthusiasts often know no boundaries where sand dunes are involved, and in fact often believe they are causing no appreciable alteration of the habitat.

At the state and county level, land has been designated primarily for recreational use, which has been disastrous to natural habitats in most cases. Nearly all of the dunes in beach and county state parks have been destroyed by intensive pressure of surfers, campers and ORV during the past two decades.

The largest islands of coastal habitats that remain are primarily in federal holdings. The most effective of these is the Point Reyes National Seashore in Marin County, which has set aside the whole foredune community as a natural preserve, a shoreline distance of some 20 kilometers. The inner dunes in this area were stabilized long ago by grasses and grazing. The largest remaining inland native, stabilized dune habitats occur on military reservations, Fort Ord in Monterey County, and Vandenburg Air Force Base in Santa Barbara County. There are small preserves designated in these areas, but the proportion of disturbance due to military activity and especially unnatural grass and Iceplant stabilization is excessive. There is not much promise of large segments of remaining native habitat being preserved.

Endemic insect species, those restricted to particular portions of the California coastal dune community, occur in several major taxa. In most cases (for example, sand-dwelling Coleoptera, predaceous Diptera) each species ranges along a series of localities in the central part of the coast. There are only a few examples of quite narrow endemics, those restricted to one or two adjacent dunes (for example in Microlepidoptera, of about 120 species as many as 40 may be endemic in California, but only about 10 are narrowly endemic). Those that are reasonably well documented occur either in the San Francisco, Monterey, Santa Maria, or El Segundo dunes, originally our largest dune systems.

Owing to the north-south shift in community composition, preservation of one or a few coastal dunes would not be sufficient to preserve all elements of the fauna and flora, especially if the areas preserved are small and involve only foredunes. The largest remaining pristine areas of unstabilized and stabilized dunes are those of the Santa Maria dune system. The greatest degree of endemism in plants and insects of all California coastal strand areas occurs in this region. To protect the best examples of diversity and narrow endemics, the greatest emphasis should be directed to preservation of parcels of the formerly largest dune systems, San Francisco, Monterey, and particularly the Santa Maria dunes.

Acknowledgments

J. T. Doyen and P. A. Rude, University of California, Berkeley, made many field collections in my interest, as did P. A. Opler, Office of Endangered Species, Department of Interior, Washington, D. C., and all three helped with development of plant lists. J. L. Strother, U. C. Berkeley Herbarium, provided identifications of plants throughout this and related studies. Assistance with compilation of data and preparation of some of the maps were provided by J. T. Sorensen, while the drawing of *Areniscythris brachypteris* was made by C. Green, Department of Entomological Sciences, U. C. Berkeley. Cooperation by authorities of various coastal dune lands made available information and access to properties under their jurisdiction, including P. Churchward, manager, Dune Lakes Ltd., P. Dubsky, Land Management Office, Ft. Ord, and R. F. Dering, U. C. Natural and Water Reserves System.

Figure 7: Dune areas adjacent to Oso Flaco Lake, San Luis Obispo County. A. looking NNW across freshwater marsh at foot of dunes, with sand encroachment already well advanced, in June, 1973. B. the same site in April, 1977 (arrows indicate primary sand road over ridge as equivalent point of reference, also pinpointed in 7C, 7E, 7G). C, D. stabilized chaparral habitat in May, 1965 (C, looking NW from ridge at left in 7A, 7B; D, looking south to Oso Flaco Lake (arrow) and the Santa Maria River Valley). E, F. the same sites, in June, 1973 and August, 1973 respectively. G, H. the same sites, in April, 1977 and October, 1977, respectively. (Arrows indicate equivalent points of reference in each series.)

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Table 1: California Coastal Sand Dune Microlepidoptera (all species).

LOCALITY (COUNTY)	ORIGINAL AREA (SQUARE KILOMETERS)	NO. DAYS SURVEYED	NO. OF SPECIES
Point St. George (Del Norte)	60	1	3
Samoa-Mad. River (Humboldt)	77	7	18
Mattole River (Humboldt)	1	1	3
Ten Mile River (Mendocino)	9	8	43
Bodega Head (Sonoma)	5	2	4
Dillon Beach (Marin)	8	1	5
Point Reyes (Marin)	26	13	32
San Francisco (San Francisco)	113	21	45
Monterey Bay (Monterey)	340	5	48
Point Sur (Monterey)	1	1	5
Morro Bay (San Luis Obispo)	55	6	16
Santa Maria (San Luis Obispo)	420	30	110
Goleta-Coal Oil Point (Santa Barbara)	2	6	[illegible]
Santa Cruz Island (santa Barbara)	2	1	3
Ventura River (Ventura)	2	1	3
El Segundo (Los Angeles)	181	1	8
San Clemente Island (Los Angeles)	2	2	14
Border Field (San Diego)	1	1	14

Table 2: Selected examples of insect species endemic to coastal dunes in California.

SPECIES (FAMILY)	DISTRIBUTION
ORTHOPTERA:	
Trimeritropis pogonata Stroh. (Acrididae)	Santa Maria
COLEOPTERA:	
Psammodius macclayi Cartwright (Scarabaeidae)	San Francisco to Newport
Psammodius doyeni Cartwright (Scarabaeidae)	Point Sur to Santa Maria
Lichnanthe ursina (LeConte) (Scarabaeidae)	Dillon Beach to San Francisco
Lichnanthe new species (Carlson) (Scarabaeidae)	Santa Maria
Coniotis eschscholtzii Mann. (Tenebrionidae)	Mendocino County to San Luis
Eleodes clavicornis Esch. (Tenebrionidae)	Sonoma to San Luis Obispo
Melanastus obesus (LeConte) (Tenebrionidae)	Point Reyes to San Luis Obispo
Necydalis rudei Linsley & Chemsak (Cerambycidae)	Santa Maria
LEPIDOPTERA:	
Glaucopsyche xerces (Boisduval) (Lycaenidae)	San Francisco
Lasionycta ochracea Riley (Noctuidae)	Point Reyes to Ventura
Eucosma hennei Clarke (Tortricidae)	El Segundo
Eucosma new species (Powell) (Tortricidae)	Monterey Bay
Grapholita edwardsiana (Kft.) (Tortricidae)	San Francisco
Argyrotaenia new species (Powell) (Tortricidae)	Morro Bay-Santa Maria
Carolella beevorana Comstock (Cochylidae)	El Segundo
Dichomeris new species (Hodges) (Gelechiidae)	Monterey to San Luis Obispo
Areniscythris brachypteris Powell (Scythrididae)	Santa Maria
Lithariapteryx new species (Powell) (Heliodinidae)	Monterey to San Luis Obispo

Table 2 Continued.

DIPTERA:	
Brennania hera (Osten-Sacken) (Tabanidae)	Marin to San Luis Obispo & San Miguel Island
Brennania belkini (Philip) (Tabanidae)	El Segundo to Ensenada
Apatolestes actites Philip & Stef. (Tabanidae)	Mendocino County to Santa Barbara and Santa Cruz Island
Ablautus schlingeri Wilcox & Martin (Asilidae)	Santa Maria
Parathalassius melanderi Cole (Empididae)	Laguna Beach
Chersodromia cana Mel. (Empididae)	Laguna Beach
Chersodromia insignata Mel. (Empididae)	Monterey

Table 3: Native plants observed at Antioch Sand Dunes, 1976-1977. Species occurring in interior California, its Central Valley, or desert affinities are indicated by an asterisk (*).

*	*Croton californicus* Nyekk.-Arg.
	Eschscholzia californica Cham.
*	*Erysimum capitatum* variety *angustatum* (Greene) G. Rossb.
*	*Eriogonum nudum* spp. *auriculatum* (var.) Benth. S. Stokes
	Gilia capitata staminea (Greene) V. Grant
*	*Heliotropium curassivicum* L. variety *oculatum* (Heller) Jtn.
*	*Datura meteloides* A. D. C.
*	*Lupinus albifrons* Benth.
	Lotus formosissimus Greene
	Lotus purshianus (Benth.) Clem. & Clem.
	Lotus scoparius (Nutt. in T. & G.) Ottley
	Quercus agrifolia Nee.
	Salix lasiolepis Benth.
*	*Clarkia unguiculata* Lindl.
*	*Oenothera deltoides* Torr. & Frem. variety *howelli* Munz
	Heteromeles arbutifolia M. Roem.
	Sambucus mexicana Presl.
*	*Hemizonia kelloggii* E. L. Greene
*	*Grindelia camporum* Greene
*	*Gutierrezia californica* (D. D.) T. & G.
*	*Heterotheca grandiflora* Nutt.
	Baccharis pilularis D. C.
	Ambrosia psilostachya D. C.
*	*Senecio douglasii* D. C.
	Bidens laevis (L.) B. S. P.
*	*Lessingia glandulifera* A. Gray
*	*Chrysopsis echioides* (Benth.) Gray

Taxa	Known only from Antioch	Known also similar arid places in Central Valley	Widespread	Last known collected date at Antioch
ORTHOPTERA:				
Neduba extincta Rentz, 1977	1			1937
Idiostatus middlekauffi Rentz, 1973	1			1965
NEUROPTERA:				
Hesperoleon infuscatus Adams, 1956		1		1949
COLEOPTERA:				
Anthicus antiochensis Werner, 1975	1			1953
Coelus gracilis Blasidell, 1939		1		1938
Dysticheus rotundicollis Van Dyke, 1953	1			1952
LEPIDOPTERA:				
Apodemia mormo langei Comstock, 1938	1			1977
Lithocolletis antiochella Opler, 1971			1	1977
DIPTERA:				
Efferia antiochi Wilcox, 1966		1		1959
Cophura hurdi Hull, 1960	1			1939
Metapogon hurdi Wilcox, 1964		1		1977
Myopa perplexa Camras, 1953			1	1937
Eumachronychia persolla Reinhard, 1965			1	1958
Thaumatomyia rubrivittata Sabrosky, 1943			1	1936
HYMENOPTERA:				
Leptochilus arenicolus Bohart, 1955	1			1939
Polistes dorsalis californicus Bohart, 1949			1	1959
Episyron quinquenotatus hurdi Evans, 1950			1	1977
Myrmosa pacifica Mickel, 1940	1			1952
Eucerceris ruficeps Scullen, 1948		1		1959
Philanthus nasalis Bohart, 1972	1			1959
Melissodes hurdi LaBerge, 1961		1		1958
Perdita scitula antiochensis Timberlake, 1960	1			1977
Perdita interserta ciliata Timberlake, 1958		1		1977
Perdita hirticeps luteocincta Timberlake, 1960	1			1936
Andrena (Cnemidandrena) luteihirta Donovan, 1977			1	1969
TOTALS: (25)	11	7	7	

Table 4: List of insect species originally described from Antioch, Contra County, California.

International Problems in Insect Conservation

Robert Michael Pyle

The Nature Conservancy, 1234 Northwest 25th Avenue, Portland, Oregon 97210, USA*

Abstract

The development of genuinely international programs for the conservation of Lepidoptera populations is reviewed. The function of the IUCN Lepidoptera Specialist Group is to coordinate such activities. Additional mechanisms for cross-country cooperation are outlined and the chief priorities discussed. Red Data books for Lepidoptera should be initiated soon and an international conference convened.

History of Insect Conservation Efforts

Parochial and national efforts at butterfly and moth conservation span the past century (Morris, 1976; Pyle, 1976a). Internationl activities in this area have developed only recently. This is understandable when one considers the long domination of world wildlife conservation efforts by concern for spectacular and valuable vertebrates such as spotted cats, ivory-bearers and crocodilians. In recent years, as local and national invertebrate conservation schemes have become sophisticated, they have begun to be mirrored at the international level.

The world situation with respect to rare Lepidoptera habitat management and legal protection was summarized by Pyle (1976b). By that time, impressive steps had been taken in a number of countries particularly the United States, the United Kingdom, and some other European nations. Although the emphasis was sometimes misplaced in favor of collecting restriction instead of habitat protection, when the latter may have been more appropriate, a surprising number of governments and private bodies had addressed insect conservation in one way or another. An awareness of the need for conserving rare populations of Lepidoptera was demonstrated in most parts of the world.

In the third quarter of the twentieth century, a few authors began to address insect conservation with an international perspective. Dumont (1971) considered the need for conservation of several threatened species of dragonflies throughout their European ranges. DeViedma and Bustillo (1976) dealt with the rare and vulnerable Lepidoptera of three countries (Spain, Portugal, and part of France) in their Red Book of Iberian Lepidoptera. Representative lepidopterists from several of the Soviet republics met in Armenia (Armenian Academy of Science, 1973) to present papers considering Lepidoptera conservation in their respective parts of Asian Russia.

One of the earliest and most far-reaching active approaches to insect conservation in the truly international context came with the founding of the European Invertebrate Survey (EIS) by John Heath and Jean LeClerq in 1969 (Heath, 1971). This multinational body serves as a biogeographical recording scheme for all European butterflies and moths, and for other invertebrates as data permits. Since accurate mapping is an essential precursor to effective conservation of populations, EIS may be considered a conservation, as well as recording organization. The Xerces Society, founded by the author in 1971, has attempted to serve world arthropod conservation since then. With members in some 20 countries, the Xerces Society reports on matters of significance and new research in all parts of the world. Papers in the journal *Atala* have dealt with issues in Poland, Taiwan, Israel, Brazil and many other places. Primarily through its reporting, the Xerces Society hopes to help bring about an international attitude toward insect conservation. One of the chief goals of the Xerces Society is to stimulate inter-national dialog in the problems of arthropod population maintenance.

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is a treaty with nearly 100 signatory parties who wish to work together to prevent economic abuses of rare organisms. The signatories agree to observe the provisions laid down by the document, mostly dealing with export and import controls. Several butterflies have been included among the species affected by the treaty. First, *Parnassius apollo* Linnaeus was placed on the most strictly controlled list, that of Appendix One (King, 1974). This was due to widespread fear of overcommercialization of rare alpine populations of this taxon. Since then, seven species of birdwing butterflies (*Ornithoptera* spp.) have been placed on Appendix Two, which requires export and import permits. *P. apollo* occurs in several mid-European countries and several of the birdwings fly both in Papua New Guinea and either the Solomon Islands or Irian Java (Indonesian New Guinea); hence this is an international measure as it relates to the point of origin. Of course, the entire operation of CITES is dependent upon the participation of signatory countries at the import level. It may be that CITES will not often be applied to insect conservation situations, since it deals primarily with trade in individuals rather than in habitat-related threats, which are immensely more important to most insect populations than collecting pressure. (Both the Apollo Parnassian and the New Guinea birdwings seem to be examples of scarce, valuable butterflies which could actually be harmed by intensive, unmonitored collecting of adults.) Nonetheless, the inclusion of appropriate Lepidoptera on the lists of this international treaty marks a significant step toward worldwide awareness of rare insect conservation problems.

*Due to developments in the field in the interim, this paper differs somewhat from that presented at the XVth Congress of Entomology.

*Present Address: Swede Park, Loop Road, Box 123, Gray's River, Washington 98621, USA

Lepidoptera Conservation as a Viable Component of World Wildlife Conservation

Full recognition of Lepidoptera conservation as a component of the world wildlife movement came in 1976. Early in that year, Sir Peter Scott, Chairman of the Survival Service Commission (SSC), established a Lepidoptera Specialist Group as a component of the SSC. The SSC is the rare and endangered wildlife branch of the International Union for Conservation of Nature and Natural Resources (IUCN). The existence of a Lepidoptera Group within SSC permits and indeed mandates the incorporation of insect habitat measures within the annual Action Programme of the Commission. The author, appointed chairman of the incipient Group, convened the first meeting of potential members in August 1976, in conjunction with the XVth International Congress of Entomology in Washington, D.C. Present were ten insect conservation biologists representing North America, South America and Europe. These individuals proposed and discussed initial priorities for the Group's attention, ways in which they could work through IUCN and the World Wildlife Fund to actually bring about habitat conservation, the proper application of CITES to insects, and a roster of additional members. It was decided that the Lepidoptera Group would temporarily serve as an umbrella group for other orders of insects. From their deliberations, a preliminary Action Programme for Lepidoptera was prepared and carried to the SSC meeting in Morges, Switzerland, by the author in the spring of 1977. This paper included a number of population- and habitat-oriented problems which the group felt warranted immediate attention for their conservation. The reaction in Morges firmly demonstrated the genuine interest in insect conservation on the part of vertebrate conservation biologists. Subsequently, the persons nominated to membership in the Lepidoptera Specialist Group were invited to serve by Sir Peter Scott. The group now numbers more than forty, making it the largest of all the specialist groups of SSC. This is not inappropriate in the context of the relative diversity of organisms covered.

The next major event in world wildlife conservation which involved insects occurred in 1977 and 1978. The United Nations Environment Program, assisted by the World Wildlife Fund, contracted IUCN's preparation of a World Conservation Strategy. The purposes of this study are to identify the major problems facing diversity survival in the world today, along with their causes and sources, treatments and solutions. It was recognized that invertebrates must be considered, in such an inquiry, alongside the traditional vertebrate groups. As a result, the author's services were contracted to prepare an invertebrate section for the Strategy. This formidable task was initiated too late for inclusion in the first published draft (IUCN, 1978). Upon its completion, the decision was made to defer publication of the invertebrate section until a third printing of the overall report, so that further information and documentation could be gathered on a wider array of organisms. Necessarily, the initial version was lopsided toward Insecta and Mollusca, with some treatment of Crustacea and Annelida. By postponing publication, it should be possible to treat several additional phyla, albeit less extensively. It is interesting to note here that Lepidoptera dominated the invertebrate section, due to the number of clearly defined and documented lepidopteran issues. The draft invertebrate section of the World Conservation Strategy will be presented for discussion by the author at the Thirtieth General Assembly of IUCN at Ashkhabad, Turkmen S.S.R., in the autumn of 1978.

Insects of Special Concern

Clearly, the World Strategy for invertebrate conservation has to be enormously selective. In fact, those cases which will eventually be included will be paradigms indicating problems common to many taxa, or habitat/community situations affecting many taxa at once. A few outstanding species will be dealt with individually due to their cultural or scientific importance. Many of the items contained in the first action programme of the Lepidoptera Specialist Group have found their way into the World Conservation Strategy as well. Some of these have already been challenged in the field. Notably, perhaps the highest world priority in Lepidoptera conservation is the protection of the wintering sites for the Monarch Butterfly (*Danaus plexippus* Linn.) in Mexico (Urquhart & Urquhart, 1976; Brower, *et al.* 1977). At present, an international consortium of specialists, conservationists and governmental authorities are coming together to develop a plan for conservation of *D. plexippus* roosts which will be consonant with appropriate land use in the areas involved. Similarly, long-term conservation of the giant birdwing butterflies (*Ornithoptera* spp.) of Papua New Guinea is an exceptional world wildlife priority. On-site investigations leading to management plans for some birdwings and other butterflies, moths, beetles and phasmids were conducted in 1977 (Pyle & Hughes, 1978). Further intensive ecological studies of protected *Ornithoptera* species are to be carried on this year and next by an international team of biologists working through the Wildlife Branch of the Papua New Guinea government. The Lepidoptera Specialist Group and its members are deeply involved in both the monarch and the birdwing projects. As they will be reported in detail in subsequent issues of *Atala*, they will not be elaborated here. Inclusion of elements such as these in the World Strategy will help to focus vital attention and funding on them as this becomes necessary.

Compatability of National and International Interests

A major problem confronting international conservation efforts is that of external desires versus internal needs. When expatriate biologists perceive preservation needs which differ from national development goals, severe conflicts may arise between sovereignty and interference. This is particularly acute and frequent in Third World countries. Embittered by many decades of colonial resource removal, newly independent nations are determined to prevent resource imperialism whether it be in the form of exploitation or preservation. It is therefore vital that the needs and priorities for conservation arise from within, or at least be embraced by the nationals of the countries involved. Papua New Guinea has forged pioneering paths in this direction. Not only does its constitution firmly espouse and intend wildlife conservation (including insect conservation), but also its people have developed wildlife management practices which permit the reservation of critical tracts of land for habitat purposes, yet without alienating it from the customary owners and users. A fine balance is necessary here, one which when successful permits both conservation of rare and vulnerable wildlife and compatible human uses. Such an approach will be essential to the Mexican monarch situation, since certain ancient human uses are too well established on the

land in question to simply displace them for a total preserve. This English-type national park concept may permit satisfactory habitat protection in countries whose resource needs are great, yet whose land is not largely held in trust by the government.

In any case, "conservation imperialism" must be avoided, for it can bring about hostility as damaging in the long run as cutting the rain forest. We must recognize the rights of sovereign peoples to self-determination of the fate of their wildlands, and try to furnish evidence for the soundest stewardship. This is more productive than making pronouncements of conservation responsibility from a posture of ignorance to the countries' human needs and traditions. In my experience, both biological conservation and moderate extraction of resources can be accomodated in tropical situations (not necessarily in the same places) as long as the tactics employed by outside advisors are helpful and respectful, not domineering and righteous. Since most of the vital issues in Lepidoptera conservation center on the tropical world, we will need to become increasingly sophisticated and sensitive in conservation diplomacy.

Mechanisms for Lepidoptera Conservation

What, then, are the mechanisms for international Lepidoptera conservation? The Lepidoptera Specialist Group of SSC, IUCN, will continue to discriminate the major needs and to advise the World Wildlife Fund on worthy projects for financial attention. The Xerces Society furnishes the pages of *Atala* and *Wings* for reportage on pertinent projects and research around the globe. The Lepidopterists' Society, with its larger international membership, can play an increasingly effective role in alerting specialists to the acute need for first-rate research and field surveys of scarce taxa and habitats. (The growing number of articles pertaining to ecology and conservation in the pages of the *Journal of the Lepidopterists' Society* is encouraging.) The recently established European Lepidopterists' Society (SEL) can do the same in its part of the world, in collaboration with the European Invertebrate Survey. I have recently been informed by Gerhard Hesselbarth, chairman of SEL's Committee for the Conservation of Biotopes and the Protection of Lepidoptera (pers. comm.) that his organization wishes to work closely with the SSC Lepidoptera Group. Similar working relationships should be sought and maintained with other geographical organizations, such as the Mexican Lepidopterists' Society, the British Butterfly Conservation Society and the Australian Entomological Society. Meanwhile, CITES will continue to review those cases whereby lepidopterans may be genuinely threatened by international trade, and to make the appropriate designations. These may be reinforced by national co-listing, such as that provided by the United States Office of Endangered Species. In the more usual problem-area, habitat threat, the American organization known as The Nature Conservancy (TNC) has an international program which, under the direction of R. Michael Wright, is interested in extending TNC's habitat conservation endeavors into the Caribbean and elsewhere.

The Future

International Lepidoptera conservation may be more advanced than most people realize. Nonetheless, the progress to date is still embryonic compared to that of vertebrate conservation. Two concrete steps need to be taken in the near future, to build momentum and to solidify the spotty successes so far realized. First, Red Data books should be developed for Lepidoptera (and eventually for other invertebrates) just as they have for vertebrate animals. The executive agency for these is IUCN, in cooperation with the World Wildlife Federation (WWF). Several representations have been made to these organizations in this regard, and their response has been promising. It is likely that Red Data studies will be underway soon at least for the butterflies and larger moths, following the excellent Iberian example of DeViedma and Bustillo. This will permit the most effective targeting of WWF funds and international energies toward the maintenance of endangered species and their habitats.

Second, an international conference should be held to discuss the issues and problems and advances in this arena. Such a colloquiam had been planned for 1976, but was deferred due to the International Congress of Entomology. It now seems appropriate to begin planning afresh for such an event. So various are the experiences of Lepidoptera conservationists around the world, so rich and challenging the array of problems they face, that a well funded international conference could prove highly catalytic. The kinds of exchange and action it would spawn might lead directly into the next era of truly international cooperation for butterfly and moth conservation.

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Concluding Remarks

John Heath

Institute of Terrestrial Ecology, Monks Wood Experimental Station, Abbots Ripton, Huntingdon, PE 17 2LS, GREAT BRITAIN

Abstract

From the papers presented at the "Endangered Insects of the World" symposium, it is concluded that insect species conservation is a worthwhile effort but that much additional research and survey is needed for this to be done effectively, in addition to the protection of habitat.

From the papers presented today and from the discussions following them, it is evident that there is an urgent need for conserving a number of insect species. For this to be done effectively, it is important that detailed field surveys be carried out to ascertain the precise status of these species thought to be endangered; that ecological studies be made to determine the habitat requirements of the species concerned; and that appropriate measures be taken to protect the habitats of endangered species.

Considerable differences of opinion were expressed as to the value of legislation, especially that aimed to limit collecting, in protecting fragile insect populations. The majority of speakers expressed the opinion that the only result would be the antagonisation of entomologists. Education of the public, especially landowners and developers would be much more effective.

The Federal Endangered Insect Program: History and Progress

Paul A. Opler

Office of Endangered Species, United States Fish and Wildlife Service, Washington, D.C. 20240, USA

Abstract

The history of federal government protection of endangered insect species in the United States is reviewed. Of 41 butterflies originally considered for inclusion on the *List of Endangered and Threatened Wildlife and Plants*, six have been designated Endangered; five others will probably be proposed for protection in the near future. In addition, two swallowtail butterflies have been designated Threatened species. Of the butterfly species now protected, habitat preservation progress has been noted for three, and slated for two. An additional two butterflies not receiving protection but included on the original Notice of Review have been included in government land management plans. It is anticipated that other species of Lepidoptera and Coleoptera will be proposed for federal protection. The major difficulty in gaining protection for declining insects, however, is the inadequate data currently available for most species.

History

On 28 December 1973, the Endangered Species Act of 1973 was enacted into law (16 U.S.C. 1531 *et. seq.*) by the United States Congress. This new law was the first piece of United States legislation to provide for the protection of insects threatened with extinction. Although not the first law in the world to protect insects, it was at the time, and remains to this day, the strongest such law passed by any nation. It is now more than four years since the passage of the Act, and I wish to review the events that have taken place as a result of the United States Fish and Wildlife Service's (USFWS) program for insect conservation.

On 20 March 1975 a Notice of Review was published in the *Federal Register* (Greenwalt, 1975a), announcing that the Service believed 41 United States butterfly taxa might be candidates for Endangered or Threatened species status (Table 1). That list was assembled, based upon our own knowledge, a literature review, and written and oral communications with many knowledgeable lepidopterists. Extensive comments were received from many lepidopterists, although the only useful data received was for California, Colorado, Minnesota, and Oregon butterflies. On the basis of data and recommendations received, six California butterflies were proposed for Endangered status later that year (Greenwalt, 1975b). In the near future it is anticipated that five additional taxa included on the original notice will be proposed for addition to the United States *List of Endangered and Threatened Wildlife and Plants*. For the remaining 30 taxa, either data are inadequate for proposal or indicate the species are not qualified for listing. A notice to that effect should be published in the *Federal Register* in the near future.

On 22 April 1975, two Florida swallowtails were proposed for Threatened status (Greenwalt, 1975c), based on recommendations made to then Assistant Secretary of the Interior, Nathaniel P. Reed a native of Florida and a Chief Counsellor of the Xerces P. Reed, a native of Florida and a Chief Counsellor of the Xerces Society, and on data supplied by Larry N. Brown (University of South Florida) and Charles V. Covell, Jr. (University of Louisville, Kentucky). *Papilio andraemon bonhotei* Sharpe is now known only from Biscayne National Monument, while *Papilio aristodemus ponceanus* Schaus is loss of habitat, particularly on North Key Largo. The National Park Service now takes both species into consideration in its management of Biscayne National Monument. The USFWS is considering the acquisition of habitat on Key Largo for *P. a. ponceanus* and other species occurring there. The final rule, published on 28 April 1976 (Greenwalt, 1976a) includes a special rule which allows collection of the adult butterflies in accordance with Florida State law, but prohibits all other activities affecting the species, except by permit.

On 14 October 1975, six California butterflies were proposed as Endangered species (Greenwalt, 1975b). On 1 June 1976, a final rule was issued (Greenwalt, 1976b), determining them to be Endangered, whereupon they were added to the United States List (Table 2). All six butterflies occur on or near the California coast (Fig. 1), and all are threatened by past and present habitat modification. Critical Habitat has been proposed for all six (Greenwalt, 1977), and should be finalized soon. A Critical Habitat is *not* a preserve, but an area within which Federal activities must be carefully planned in consultation with the USFWS.

Conservation Progress

Positive conservation results have already taken place for three of the species. For *Apodemia mormo langei* Comstock, the Service plans a refuge addition to the San Francisco Bay National Wildlife Refuge, while Pacific Gas and Electric Company will probably cooperate in the protection of their land adjacent to the Refuge. Jerry A. Powell and other San Francisco, California area biologists have been instrumental in helping this come to pass. At least eight other insects are (or were) endemic to the area which is also shared by two Endangered plants--the Antioch Dunes Evening Primrose (*Oenothera deltoides howellii* Munz) and Contra Costa Wallflower (*Erysimum capitatum* var. *angustatum* (Greene) G. Rossb.).

Table 1: Butterfly species listed in first Notice of Review, March 1975.

FAMILY PAPILIONIDAE	
Parnassius clodius strohbeeni Sternitzky	Strohbeen's Parnassius
FAMILY PIERIDAE	
Anthocharis cethura catalina Meadows	Catalina Orange-Tip
Euchloe hyantis andrewsi Martin	Andrew's Marble
Eurema dina dina (Poey)	Dina Yellow
FAMILY SATYRIDAE	
Euptychia mitchellii French	Mitchell's Satyr
Cercyonis meadii alamosa Emmel & Emmel	Mead's Satyr
Oeneis chryxus valerata Burdick	Chryxus Arctic
FAMILY NYMPHALIDAE	
Speyeria nokomis nokomis (Edwards)	Great Basin Silverspot
Speyeria nokomis apacheana (Skinner)	Apache Silverspot
Speyeria nokomis nitocris (Edwards)	Mountain Silverspot
Speyeria nokomis coerulescens (Holland)	Blue Silverspot
Speyeria serene myrtleae dos Passos & Grey	Myrtle's Silverspot
Speyeria serene hippolyta (Edwards)	Oregon Silverspot
Speyeria adiaste adiaste (Edwards)	Unsilvered Silverspot
Speyeria adiaste clemencei (J. A. Comstock)	Clemens's Silverspot
Speyeria adiaste atossa (Edwards)	Atossa Silverspot
Speyeria egleis tehachapina (J. A. Comstock)	Tehachapi Mountain Silverspot
Euphydryas editha wrighti Gunder	Wright's Checkerspot
Euphrydryas editha monoensis Gunder	Mono Checkerspot
Limenitis archippus obsoleta Edwards	Obsolete Viceroy
Poladryas minuta Edwards	Minute Checkerspot
FAMILY LYCAENIDAE	
Eumaeus atala florida (Rober)	Atala
Callophrys mossii bayensis Brown	San Bruno Elfin
Callophrys mossii doudoroffi (dos Passos)	Doudoroff's Elfin
Callophrys mossii windi (Clench)	Wind's Elfin
Callophrys lanoraieensis (Sheppard)	Bog Elfin
Callophrys hesseli Rawson & Ziegler	Hessel's Hairstreak
Vaga blackburni (Tuely)	Hawaiian Hairstreak
Lycaena arota nubila J. A. Comstock	Clouded Tailed Copper
Lycaeides melissa samuelis Nabokov	Karner Blue
Lycaeides argyrognomon lotis (Lintner)	Lotis Blue
Icaricia icarioides missionensis (Hovanitz)	Mission Blue
Icaricia icarioides pheres (Boisduval)	Pheres Blue
Icaricia icarioides moroensis (Sternitzky)	Moro Blue
Shijimiaeoides enoptes smithi Mattoni	Smith's Blue
Shimijiaeoides battoides allyni Shields	El Segundo Blue
FAMILY RIODINIDAE	
Apodemia mormo langei J. A. Comstock	Lange's Metalmark
FAMILY MEGATHYMIDAE	
Stallingsia maculosus (H. A. Freeman)	Maculated Manfreda Skipper
Megathymus coloradensis kendalli H. A. Freeman	Kendall's Yucca Skipper
FAMILY HESPERIIDAE	
Hesperia dacotae (Skinner)	Dakota Skipper
Problema bulenta (Boisduval & LeConte)	Rare Skipper
Panoquina panoquinoides errans (Skinner)	Salt Marsh Skipper

Table 2: Butterflies currently on the United States *List of Endangered and Threatened Wildlife and Plants.*

Shijimiaeoides battoides allyni	EL SEGUNDO BLUE
Apodemia mormo langei	LANGE'S METALMARK
Lycaeides argyrognomon lotis	LOTIS BLUE
Icaricia icarioides missionensis	MISSION BLUE
Callophrys mossii bayensis	SAN BRUNO ELFIN
Shijimiaeoides enoptes smithi	SMITH'S BLUE

Figure 1: Map of California, showing location of six Endangered butterflies.

Figure 2: The "Smith's Blue Butterfly Preserve," located within the Fort Ord Military Base in Monterey County, California. Photo by L. Orsak.

A colony of *Shijimiaeoides enoptes smithi* (Mattoni) within the boundaries of Fort Ord (United States Army-owned) has been made a "Smith's Blue Preserve" by the Army (Fig. 2), one of ten or more habitat preserves on that base, which straddles the most extensive remnants of the Monterey Dunes system (Monterey County).

The El Segundo Blue Preserve established on Standard Oil Company property in El Segundo (Los Angeles County), California, has been described by Oppewall (1976). In addition, a large colony exists on land surrounding an airplane guidance facility at the west end of Los Angeles International Airport. This land is within the proposed Critical Habitat for the El Segundo Blue (*Shijimaieoides battoides allyni* Shields).

In the San Bruno Mountains (San Mateo County, California), land harboring some *Callophrys mossii bayensis* Brown and *Icaricia icarioides missionensis* (Hovanitz) colonies and previously slated for housing development is now slated for a San Mateo County Regional Park, and some conservation of the two butterflies is likely.

For two of the butterflies included on the March 1975 Notice of Review but not yet proposed for addition to the United States Endangered species list, conservation efforts are already in progress. The Bureau of Land Management (Department of the Interior) is featuring the conservation of Colorado's largest *Speyeria nokomis* (Edwards) colony in its management of Unaweep Canyon. In Oregon, the United States Forest Service (Department of Agriculture) is conserving one of the few remaining *Speyeria zerene hippolyta*) (Edwards) populations in its management plan for Suislaw National Forest.

Future Actions

Current plans by the USFWS call for the proposal of ten Lepidoptera and ten Coleoptera in the next few months, while more than 500 other insects are being evaluated in regard to their status. Appropriate data on location, trends, and threats to most insect candidates are inadequate, and readers can best contribute by providing such data.

Insects in other countries may be added to the United States List under provisions of the Endangered Species Act, but such species would receive real protection only if overcollecting and subsequent import into the United States was a major factor leading to their decline. To date, most of our efforts have gone to the listing of United States insects and protection of their habitats.

The USFWS encourages the Xerces Society and its members to continue their fine efforts on behalf of insect conservation.

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EDITORIAL STAFF OF *ATALA*

SUGGESTIONS FOR CONTRIBUTORS

Formal scientific articles and notes dealing with any aspect of the ecology and conservation of endangered or threatened terrestrial arthropods are solicited. Articles will generally be longer papers, notes not exceeding 1000 words. Reviews of books dealing with terrestrial arthropod conservation or endangered habitats are also invited. Appropriate philosophical papers will be welcomed for use in the "Commentary" section.

All manuscripts should be typewritten on white, 8½ x 11 inch, good quality bond paper, on one side only, double- or triple-spaced throughout, with margins of at least one inch on all sides. The original typescript and at least one (preferably two) xeroxed or carbon copies should be submitted; authors should also retain a copy of manuscripts and figures for later consultation with the editors.

Please include illustrations if appropriate. Figures should be consecutively numbered in Arabic numerals. Hand-drawn figures should be rendered in black ink on good quality white paper. They may be larger than final reproduced size. Black and white glossy photographs may also be submitted. These and artwork will be returned after publication if accompanied by return postage. Figure captions should be typed, double-spaced, on a separate sheet, and the number of the figure lightly pencilled on the back of each drawing or photograph. A sketch map should be included as a figure with all articles or notes dealing in a major way with a specific region or arthropod habitat.

Cover art changes with each issue, and contributions will be gratefully received. Cover illustrations should generally show insects or other arthropods in *living* poses, and prospective cover artists should consult with the Editor before submitting material.

Tables should be numbered consecutively in Arabic numerals and submitted in photo-ready condition on separate sheets. Please include full scientific name, *with authors*, for both plants and animals mentioned in any manuscript submitted for publication in *Atala*. The metric measurement system should be used, with English system equivalents in parentheses if desired. Full references to literature cited should appear in a separate section at the end of articles or commentary papers, but should be parenthetically incorporated within the text of notes. Please include an *informative abstract* of approximately 150 to 250 words with all articles. Avoid footnotes to text statements if possible; such information can usually be included within the text. Words to be set in *italics* should be underlined. Reprints of articles are available at cost. An author will receive a reprint order form after acceptance of a manuscript. The style of *Atala* generally follows that recommended in the *CBE Style Manual* (1972). Abbreviations of journal titles follow *Bibliographic Guide for Editors and Authors* (1974).

Prospective authors may request a copy of the detailed editorial policy of *Atala* from the Editor.

COVER

The recently discovered *Areniscythris brachypteris* Powell, a jumping, flightless moth which buries itself at night; a narrowly endemic species known only from the Santa Maria dune system, San Luis Obispo County, California. The survival of the species hinges on the fate of its habitat, which has already been extensively reduced by urban and agricultural growth; also off-road vehicle use. See article by Jerry A. Powell in this issue.

The pen-and-ink drawing was rendered by Celeste Green, formerly of the Department of Entomology, University of California, Berkeley.

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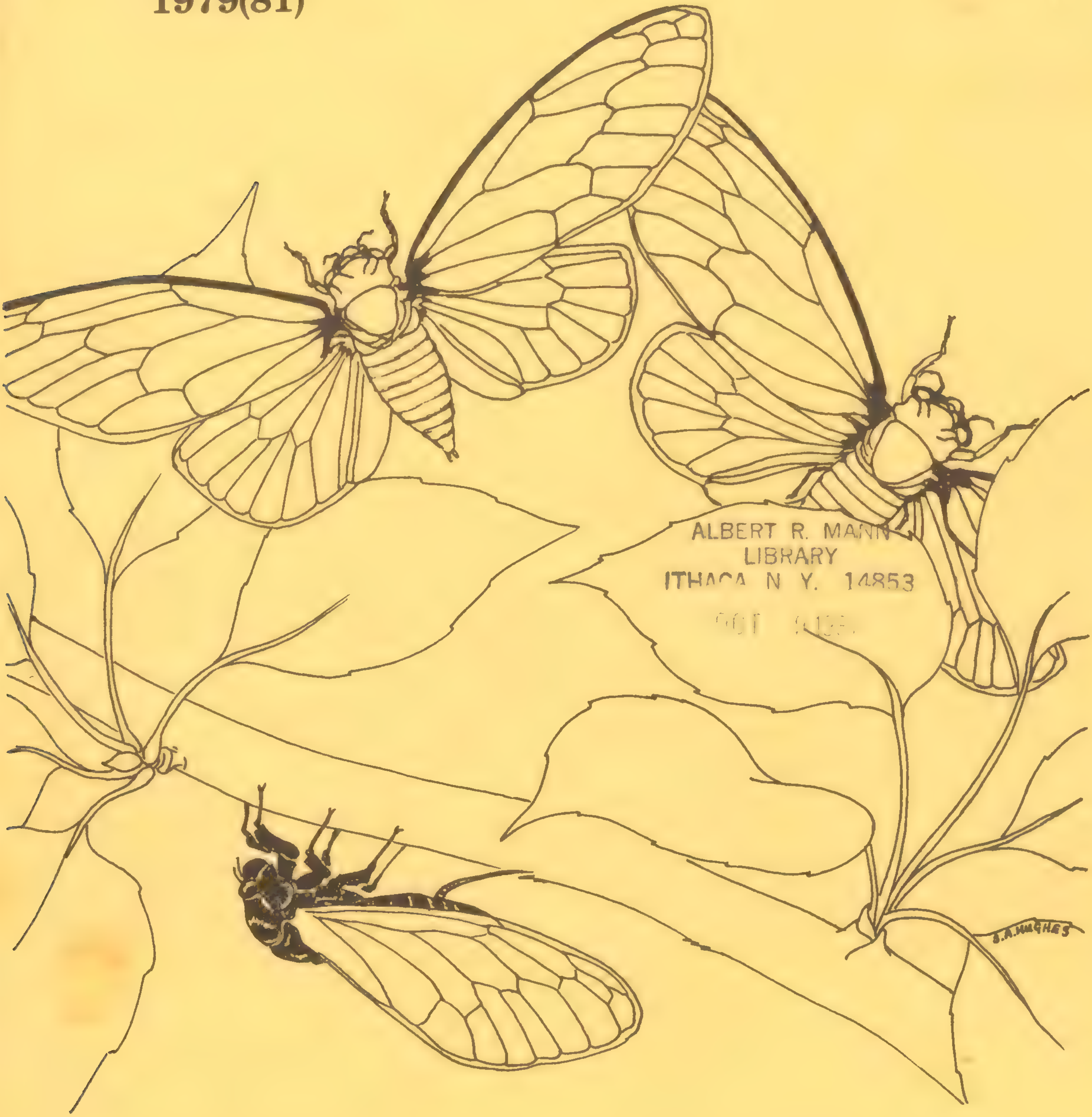

THE XERCES SOCIETY

An international, non-profit organization dedicated to the conservation of terrestrial arthropods and their habitats. Named for the extinct Xerces Blue Butterfly, *Glaucopsyche xerces* (Boisduval). Founded on 9 December 1971.

MEMBERSHIP INFORMATION

Membership in the Xerces Society is open to all interested persons and institutions upon submission of appropriate dues. Adult memberships and institutional subscriptions are US $8.00 and student memberships are US $4.00 for the 1980 calendar year. All members and institutional subscribers normally receive the journal *Atala* twice yearly; the less formal newsletter *Wings* three times yearly; *Self-Help Sheets* (informal, how-to-articles) and *Educational Leaflets* (short, informal, informational) irregularly, as they are issued; and Society meeting announcements, membership lists, and other communications. Xerces Society publication and administration costs are covered by dues and contributions, all of which are tax-deductible. A person or institution interested in receiving Xerces Society publications should submit name, address, and appropriate dues to the Treasurer, *Stephen Chang, 304 West 236th Street, Bronx, New York 10463, USA.*

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Published at Los Angeles, California, USA, in May 1981, by the Xerces Society in cooperation with The Lepidoptera Research Foundation.

ATALA

JOURNAL OF THE XERCES SOCIETY

Volume 197 Number

Commentary

A Xerces Society Office Fundraising Campaign

Robert Michael Pyle

Swede Park, Loop Road Box 123, Gray's River, Washington 98621, USA

Subscribers to this journal often wonder when it will appear or whether it has ceased publication altogether. As we have explained before, our strictly voluntary nature has had the drawback of unpredictability. Due to the large amount of correspondence generated by conservation action work, our ability to maintain a regular publication schedule has proved inadequate.

Nonetheless, there is no shortage of vitality in the Society and no intention whatever of allowing the publications to lapse permanently. On the contrary, we plan to be back on schedule with *Atala* by late 1981. In the meantime, we thank you for your forebearance and hope you will continue supporting the Society.

At the annual meeting of the Xerces Society in Baltimore in April 1979, the Board of Directors took an important decision: A fundraising campaign was authorized to finance the opening of an office and hiring of a basic staff. This development, it is felt, will bring about the level of professionalism we need to reach our potential in conservation action and to achieve regularity with all of our publications, as well as to keep up our successful Fourth-of-July Counts and grants program.

The campaign is underway. Our goal is to raise US $100,000 in order to open and staff the office by the Society's tenth anniversary in late 1981. Early response has been gratifying, but we have a long way to go.

I hope that all Xerces members will consider a modest or major contribution over and above their dues for 1980. Please mark any such donations "development fund" and send (along with any suggested contacts) in care of R. M. Pyle, Swede Park, Loop Road Box 123, Gray's River, Washington 98621 USA. Checks should be made out to the Xerces Society. All donors to the development fund will be acknowledged in a special, tenth anniversary edition of *Atala, unless* they wish to remain anonymous. Of course, all contributions are tax-deductible.

Articles

Santa Catalina Island's Endemic Lepidoptera I. The Orange-Tips, *Anthocharis cethura catalina* and *Anthocharis sara gunderi* (Pieridae)

Lawrence F. Gall*

Department of Biological Sciences, Stanford University, Stanford, California 94305, USA

Abstract

The Catalina orange-tip, *Anthocharis cethura catalina*, successfully eluded both collectors and researchers for nearly half a century. The butterfly had been suggested for threatened or endangered species status until very recently, although its biology and ecology remained virtually unknown. Investigation of habitat utilization and management on Catalina Island, hostplant relations, distributional records, and the behavioral ecology of *A. c. catalina* indicates that neither the butterfly nor its habitat are imminently threatened. Ecological relationships between the Catalina orange-tip and the related Gunder's orange-tip, *Anthocharis sara gunderi*, on Catalina Island are also discussed.

Introduction

In the Northern and Southern California Islands, southern California possesses an assemblage of offshore field sites uniquely suited for the investigation of evolutionary processes in isolated ecosystems. The 1967 Biological and 1978 Multidisciplinary Symposia on the California Islands held in Santa Barbara reflect increasing scientific interest in these islands over the past few decades. However, apart from sporadic publications from research and collecting trips, the entomology of the Southern California Islands is not well known. This paper focuses on the biology and ecology of one of Santa Catalina Island's endemic butterflies, the Catalina orange-tip (*Anthocharis cethura catalina* Meadows; Fig. 1).

History of Lepidoptera Research on Santa Catalina Island

Don C. Meadows, a schoolteacher in Avalon and an ardent naturalist, began publishing a list of the Lepidoptera on Santa Catalina Island, of which only two parts appeared, during the late 1930s. In his Rhopalocera checklist, Meadows (1936) described *A. c. catalina* from a series of twelve specimens captured at various localities on the island; he did not present any biological information on this or the other Catalina butterflies apart from brief distributional notes. Thorne (1970) published an account of his collecting trip for the Avalon hairstreak, *Strymon avalona* Wright, and Orsak (1976) detailed an expedition for *A. c. catalina*. Of the three, only Orsak's article attempted to deal with substantive biological and ecological considerations.

Figure 1: A male (A) and female (B) of the Catalina orange-tip, *Anthocharis cethura catalina*. Both specimens captured on Santa Catalina Island, Los Angeles County, California, 24 March 1978: male taken 1.0 kilometer south-southeast of Avalon, elevation 200 meters; female taken 1.3 kilometers south-southeast of Avalon, elevation 300 meters.

It is unfortunate that so little work has been done on Catalina's Lepidoptera, especially since this island is endowed with several distinctive, virtually uninvestigated endemics. Catalina Island is also the most accessible of the Southern California group to California collectors. As Orsak (1976) noted, perhaps the "inaccessibility of [*A. c.*] *catalina* habitats (physical and/or legal), short flight period of adults, possible confusion with *Anthocharis sara gunderi* [Ingham], and the tendancy of local collectors not to exert much energy searching for a relatively unspectacular-looking butterfly" account for the paucity of published information. Fortunately, interest in Catalina's butterflies has recently accelerated. At the time of this writing a study of *S. avalona* and its hostplant relationships is in progress (Glenn A. Gorelick, pers. comm.). The second article in this series on Catalina Island's endemic Lepidoptera will address the biological and conservation implications of the common hairstreak's (*Strymon melinus* Huebner) recent arrival on Catalina Island.

*Present address: Dept. of Biology, Yale University, New Haven, CT 06520, USA

Distributional Records for *A. c. catalina*

During the late 1920s and early 1930s, Meadows obtained his type series of *A. c. catalina* from several localities, including Grand Canyon, Little Harbor, the Renton Mine area, Salta Verde, and White's Landing. In this era Charles Ingham also collected several specimens at Middle Ranch and Silver Canyon. Meadows' butterfly specimens are currently housed in the Natural History Museum of Los Angeles County (holotype, allotype), the Bowers Museum in Santa Ana, California (paratypes), and the University of California, Irvine collection (paratypes). Many of Ingham's butterflies and some of Meadows' from the P. S. and C. L. Remington collection are in the entomological collections at the Peabody Museum of Natural History (Yale University).

It was not until 1968, when Paul Opler and Jerry Powell collected a single female at Little Harbor, that additional records for *A. c. catalina* surfaced. Larry Orsak took three males and a female on the firebreaks south of Avalon in 1975, and included sight records from these and adjacent ridges. In 1976, I took a single male southeast of Avalon on Wrigley Drive near its junction with the Renton Mine Road. In 1977 I was unable to locate *A. c. catalina* after hiking over most of the island. In all likelihood this scarcity was due to the prolonged, severe drought which decreased butterfly numbers and diversity throughout California. In 1978 *A. c. catalina* was present at several localities: along the firebreaks south of Avalon, at the Wrigley Drive locality, and on several firebreaks above the Isthmus at the northwest end of the island. Glenn Gorelick (pers. comm.) collected several specimens and observed others while looking for *S. avalona* at the latter locality. Fig. 2 shows the locations of all *A. c. catalina* captures of which I am presently aware, with old (1930s) records distinguished from recent ones.

Locality data for these specimens are as follows: all California, Los Angeles County, Santa Catalina Island. Grand Canyon: ♂, ♀, 1 April 1933, DM; ♂, ♀, 9 April 1933, DM. Little Harbor: 2 ♀, 31 March 1928, DM; ♀, 1 April 1968, leg. P. Opler & J. Powell. Middle Ranch: ♂, 2 April 1932, leg. C. H. Ingham. Renton Mine: ♂, 23 March 1930, DM; 3 ♂, 28 March 1930, DM. Silver Canyon: ♂, 30 March 1932, leg. C. H. Ingham. Salta Verde: ♂, 15 April 1930, DM. White's Landing: ♂, 7 April 1929, DM. Firebreak 1.5 km NW of Two Harbors: ♂♂, ♀♀, 24-26 March 1978, leg. G. A. Gorelick. Firebreaks 1.0 km SSE of Avalon, elev. approx. 200 m: 2 ♂, 20 April 1975, leg. L. J. Orsak & C. R. Roseland; ♂, 24 March 1978, LFG. Firebreak along summit ridge near Cactus 2 Mountain, 1.3 km SSE of Avalon, elev. 300 m: ♂, ♀, 24 March 1978, LFG; 26 March 1978, LFG. Ridge 2.1 km S of Avalon, elev. 335 m (South Firebreaks of Fig. 2): ♂, ♀, 20 April 1975, leg. L. J. Orsak & C. R. Roseland. Wrigley Drive, 1.3 km SE of Avalon, elev. 100 m: ♂, 26 March 1976, LFG. Sight records have not been included in the above list; collection abbreviations are for Lawrence F. Gall (LFG) and Don Meadows (DM).

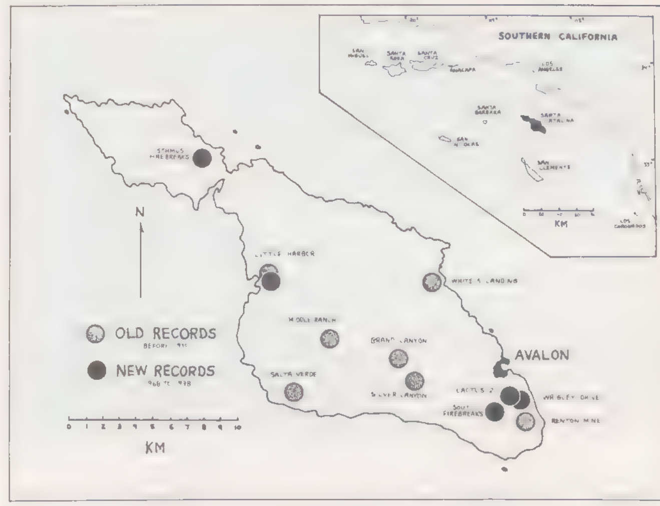

Figure 2: Localities where *A. c. catalina* has been captured on Santa Catalina Island over the past 50 years. Each circle represents a single collection locality; see text for numbers of individuals at each locality. Inset shows the position of Santa Catalina Island and the other major Channel Islands relative to the Southern California coastline.

Habitat

The Northern California Island group contains Anacapa, San Miguel, Santa Cruz, and Santa Rosa Islands while the Southern group is composed of San Clemente, San Nicolas, Santa Barbara, and Santa Catalina Islands. Santa Catalina Island is located 32 kilometers south of the Palos Verdes Peninsula, and is the largest in the Southern California group with an area of approximately 200 square kilometers. It is 35 kilometers long, with the main axis running southeast to northwest, and ranges from less than 1 kilometer wide at the Isthmus to nearly 13 kilometers wide near its center. The main axis is traversed by a central ridge generally some 450 meters high, with the two highest peaks, Mount Orizaba and Black Jack Mountain, rising to 613 and 630 meters respectively. Most of the coastal topography is rugged and precipitous, with bluffs rising abruptly to 350 meters or more.

The Catalina orange-tip is a denizen of the dry, rocky slopes characteristic of the exposed ridgetops and firebreaks on Catalina Island. The plant communities associated with these regions are the Chapparal and Coastal Sage Scrub of Thorne (1967). Figs. 3 and 4 show representative views of my Cactus 2 Mountain study site, 1.3 kilometers south-southeast of Avalon, elevation 270-310 meters. Fig. 5 details the firebreak system around Cactus 2 Mountain. The ridge edges are flanked by stands of *Rhus integrifolia* (Nutt.) Benth. & Hook. ex Rothr., *Rhus laurina* Nutt. in T. & G., *Arctostaphylos subcordata* Eastw., and *Quercus dumosa* Nutt. Interspersed between these shrubs and trees are many native and introduced herbs, most notably *Sanicula arguta* Greene ex Coult. & Rose, *Artemesia californica* Less., *Lotus argophyllus* (A. Gray) Greene ssp. *ornithopus* (Greene) Raven, *Erodium cicutarium* (L.) L'Her., *Salvia mellifera* Greene, *Adenostoma fasiculatum* H. & A., *Castilleja affinis* H. & A., various grasses, and other members of the families Brassicaceae, Asteraceae, and Fabaceae. On the southern slopes of the firebreak network are dense, impenetrable stands of prickly-pear cactus (*Opuntia* spp.), separated by small pockets of scrub and dirt. The firebreaks are for the most part dry, rocky, and desolate, although occasional small annuals have become established near the edges.

Throughout my stay from 24 to 26 March 1978 the daytime temperature fluctuated between approximately 10 to 15 degrees Centigrade in early morning and 18 to 25 degrees Centigrade in mid afternoon. Clear skies predominated, with occasional high cloudiness in the afternoons. Fog was present on 26 March in the vicinity of Avalon but only to an elevation of about 100 meters. Winds were generally light from the west.

Figure 3: The southwest ridge of the Cactus 2 Mountain firebreak complex as viewed from the western edge of the summit ridge (looking southwest at an elevation of 290 meters). Large stands of *Opuntia* and *Descurainea pinnata* are visible immediately to the right of the firebreak.

Figure 4: The summit ridge of Cactus 2 Mountain as seen from the firebreak leading south from Avalon (looking south at an elevation of approximately 230 meters).

Figure 5: A map of the Cactus 2 Mountain firebreak complex south of Avalon, the main study site for *Anthocharis cethura catalina*.

Behavior and Movements of Adults

Males

After observing *A. c. catalina* and *A. s. gunderi* on 23 March 1978 I felt confident in separating the two during flight. Males of *A. c. catalina* fly rapidly in an erratic but primarily straight path, while males of *A. s. gunderi* fly more slowly and tend to wander. These distinctions are markedly reduced for the females of both species, although femaies fly slowly enough that the distinct sexual wing pattern differences are readily discernible. In addition there is a partial altitudinal separation between the two, with *A. c. catalina* occupying the ridgetops and adjacent slopes,and *A. s. gunderi* inhabiting the lower, moister canyons. However, females of *A. s. gunderi* were observed near the summit ridges in company with both sexes of *A. c. catalina* (see Discussion).

Males of *A. c. catalina* are strong hilltoppers. At the Cactus 2 Mountain study site males flew a stereotyped route along the southwestern ridge to the northeastern end of the summit ridge; from this point they would fly back and forth along a 100 meter stretch several times before returning down the southwest ridge. Of 14 males observed, 11 patrolled the northern edge of the summit ridge, and all flew down the southwest ridge after hilltopping (Fig. 6A). While photographing and trailing females on 25 and 26 March, I saw some five to ten additional males flying on the ridges. At 1055 and 1100 Pacific Standard Time on 24 March, males were observed nectaring from the lavender blossoms of *Erodium cicutarium*. On Cactus 2 Mountain male *A. c. catalina* were seen only during the following periods: 24 March, 1010-1120 hours; 25 March, 1115-1230 hours; 26 March, ?-1230 hours. On the firebreaks northwest of Two Harbors a similar, pronounced late morning activity pattern was also observed (Glenn Gorelick, pers. comm.). I was either on the summit ridge of Cactus 2 Mountain or within five minutes' hike at 0930 hours on 24 March and 0940 hours on 25 March, and left each day at least forty-five minutes after the last male seen; on 26 March I did not reach the ridge until 1100 hours, at which point males were immediately visible hilltopping.

Females

Females of *A. c. catalina* were seen flying on or near the firebreaks between 1000 and 1200 hours Pacific Standard Time during March 1978. At 1025 hours on 24 March a single female approached the summit ridge from the southwest, flying directly and swiftly toward the area used by males for hilltopping. This specimen was netted and dissected; it contained no spermatophores. At 1115 hours on 25 March a second female was followed as it flew slowly amongst the low plant growth below the summit ridge, apparently searching for oviposition substrates. It nectared several times from the yellow blossoms of *Sanicula arguta* and occasionally investigated small annual lupines and *Erodium cicutarium* plants. At 1127 hours the female oviposited once on a five to seven centimeters tall tansy mustard, *Descurainea pinnata* (Walt.) Britt. ssp. *menziesii* (DC.) Detl. on the north ridge. The egg was deposited on the upper surface of a young leaf near the inflorescence. The female clearly relied first on visual cues when locating oviposition substrates, as evidenced by her investigation of plants similar in size and shape to small *Descurainea*. Presumably secondary visual and/or chemotactile cues released oviposition activity.

Two other females were seen but not followed or captured in the study area (one each on 24 and 25 March, 1115 to 1130 hours). Fig. 6B details the flight paths for each of the four female *A. c. catalina* observed; no others were seen during the remainder of the study period.

Upon careful inspection of the entire north ridge, no other specimens of *Descurainea pinnata* were found. However, several large stands were discovered halfway along the southwest ridge (Figs. 5, 7, and 8). At 1300 hours on 26 March a female *A. s. gunderi* slowly approached the southwest ridge

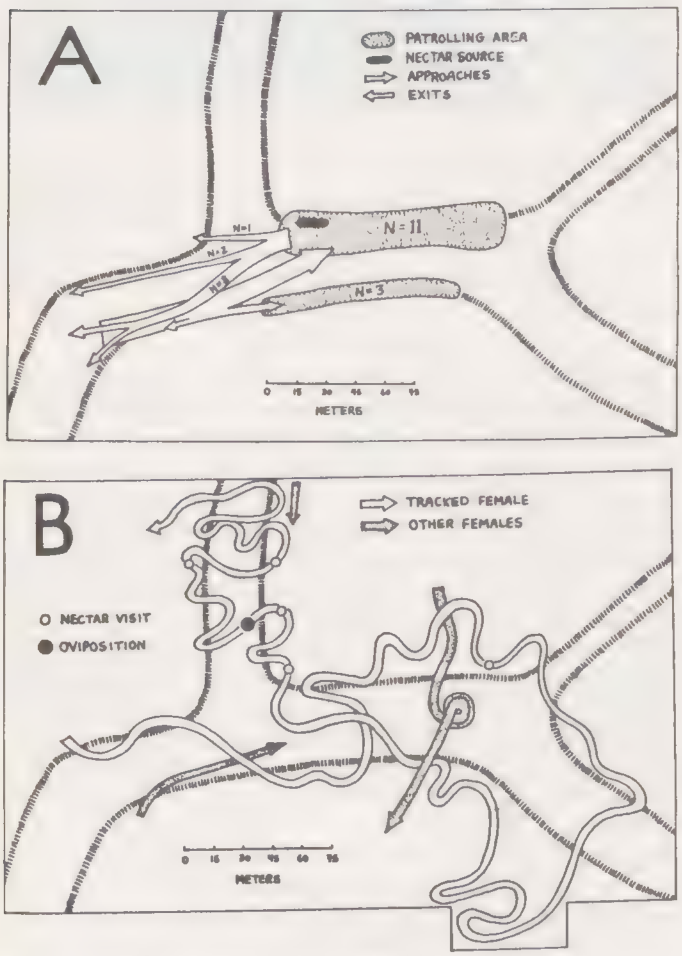

Figure 6A: Flight patterns of hilltopping male *A. c. catalina* along the summit ridge of Cactus 2 Mountain, 24-26 March 1978. Nectar visits were to *Erodium cicutarium*.

Figure 6B: Flight patterns of female *A. c. catalina* around Cactus 2 Mountain, 24-25 March 1978. Nectar visits to *Sanicula arguta*; oviposition was on *Descurainea pinnata*.

from below. At 1310 hours this female landed on a *Descurainea* plant and oviposited once on the undersurface of a mature frond halfway up the stalk. Further searches uncovered two additional *Anthocharis* ova (species identity undetermined) within this *Descurainea* patch. Other *A. s. gunderi* females were seen in the area (two) and much farther downslope (two) but were not observed ovipositing. Cruciferous plants along the southwest slope included: *Brassica kaber* (DC.) Wheeler, *Capsella bursa-pastoris* (L.) Medic., *Descurainea pinnata*, various *Lepidium* spp., *Raphanus* spp., *Sisymbrium altissimum* L., and *Thysanocarpus laciniatus* Nutt. ex T. & G. *Descurainea pinnata* was the most abundant member of the genus.

Discussion

A. c. catalina appears to be thriving on the island. I agree entirely with Orsak's assessment of this butterfly's present status (1976, p. 87): "First and foremost, the Catalina orange-tip is still extant on Santa Catalina Island. Additionally, fear that the subspecies was endangered appears unfounded... it may probably be expected to occur on many, if not most, of the rather inaccessible ridges in the area of Avalon." Indeed, Gorelick's population near the Isthmus represents a northern record for the butterfly. However, I was unable to locate *A. c. catalina* on several adjacent and seemingly suitable ridgetops near Avalon, including Meadows' choice locality (ridgetop between Renton Mine and Jewfish Point, two miles south of Avalon, at the head of Pebbly Beach Canyon).

That Catalina's numerous feral goat herds accelerate erosion, particularly on the ridgetops, by trampling upon and overgrazing the available forage (Coblentz, 1977) would also seem to favor *A. c. catalina*, as the butterflies and their host were found most frequently around the eroded firebreaks rather than the more vegetated slopes. *Descurainea pinnata* is a 'weedy species,' characteristically prevalent in grasslands and heavily grazed or disturbed areas (Twisselmann, 1967). Moreover, this plant is highly poisonous to range cattle and sheep, presumably from its ability (as with many members of the Brassicaceae) to concentrate noxious defensive compounds e.g. mustard oil glycosides, in its tissues (Chew, 1974; Kingsbury, 1964; Schmutz *et. al.*, 1968). These characteristics suit *Descurainea pinnata* particularly well for colonizing the heavily grazed habitats on Santa Catalina Island.

There is also evidence that *A. c. catalina* diapauses through environmentally unsuitable years, e.g. during the 1976/1977 drought. As mainland *A. cethura cethura* (Felder & Felder) is univoltine (I assume *A. c. catalina* is as well although no verification is presently available) and no specimens were seen throughout my 1977 stay, which included a three-day hike over much of the island, this suggests that the 1978 adults were derived at least in part from immatures diapausing through 1977 and perhaps earlier years. Although *A. c. catalina*'s emergence in 1977 may have been missed—frequent variations in flight seasons are common in desert butterflies—this seems unlikely, as species flying with *A. c. catalina* in both 1976 and 1978 (*Anthocharis sara gunderi*, *Celastrina argiolus echo* [Boisduval], and the early spring brood of *Strymon avalona*) were present in fair to good wing-wear condition during my stay in 1977. Moreover, John Emmel (pers. comm.) reared non-desiccated adults of central Nevadan *Anthocharis cethura* from pupae which had been in diapause for five years. These observations suggest that temperature and/or humidity are important determinants affecting long-term diapause in *A. c. catalina*.

While most *A. c. catalina* males observed have been hilltopping, several have been captured away from summit ridges. I took one male flying parallel to a level road at 1315 hours on 26 March 1976 at an elevation of 100 meters, and saw another flying rapidly downslope at an elevation of 150 meters at 0930 hours on 26 March 1978. Orsak (1976) noticed no strong hilltopping behavior in *A. c. catalina* during his 1975 visit to Santa Catalina Island. He captured two males flying upslope at an elevation of 200 meters around 1230-1300 hours, and a pair flying upslope at an elevation of 335 meters at 1445 hours (L. J. Orsak, pers. comm.). These localities are all at least 50 meters below the nearest respective summit.

Figure 7: A large stand of *Descurainea pinnata*, the host for *A. c. catalina* and *A. sara gunderi* at the Cactus 2 Mountain site; looking west from the southwestern ridge at an elevation of approximately 285 meters.

Figure 8: Closeup of a stand of *Descurainea pinnata* in the middle of the southwestern ridge, looking northwest at an elevation of approximately 285 meters. Penknife is 9 centimeters long; note that the plants are growing on very dry, rocky soil on this firebreak, in one of the most disturbed habitats in the area.

Shields (1967) reported predictable summit approach patterns similar to those in the present study for hilltopping male *A. cethura cethura* on the southern slopes of Dictionary Hill, San Diego County, California. Similar daily summit arrival times have also been reported for *A. cethura pima* Edwards in Arizona (K. Roever *in* Shields, 1967). Although Roever's data are not directly comparable, they clearly indicate the preference of male *A. c. pima* for summits during mid to late morning hours (Fig. 9). Fig. 10 details capture times for female *A. c. catalina* on Cactus 2 Mountain and *A. c. cethura* on the summit of Dictionary Hill (adapted in part from Shields & Emmel, 1973). These data indicate a similar preference of female *A. cethura* for ridgetops during mid to late morning.

As the ridges warmed during early morning on Catalina Island on 24 and 25 March 1978, I observed large numbers (often as many as two to five per minute) of the white-lined sphinx moth, *Hyles lineata* (Fabr.), flying along the firebreaks. Their flight ceased just prior to the appearance of *Anthocharis* on these days. Flight activity of both *Anthocharis* and *Hyles* on the ridgetops is probably restricted by thermal considerations. Like most butterflies, orange-tips are ectotherms and regulate their body temperature by appropriate orientation to incident radiation (see for example Watt, 1968). From midday through late afternoon the bare ridgetops are extremely hot, and undoubtedly present an intolerable solar/re-radiation load to many insects. Early morning probably necessitates frequent solar warm-up for orange-tips although activity would not be restricted for *Hyles*, since sphinx moths can regulate body temperature via endothermic mechanisms (Heinrich, 1971). Thus, mid to late morning may be the only time thermally available to *A. c. catalina* for hilltopping.

Moreover, it may be that female *A. cethura* are most readily visible to males during the morning; Leigh & Smith reported that 'alba' *Colias eurytheme* are harder to spot than their yellow counterparts from midday to late afternoon. In several montane *Colias* species, the number of male approaches to tethered 'alba' females decreases abruptly after 1130-1200 hours; an element of differential visibility is certainly involved, along with other biophysical factors (Gall & Graham, unpublished data).

Under similar environmental conditions as in the present study, Shields & Emmel (1973) observed copulation in *A. c. cethura* during the middle of the morning (approximately 1030-1230 hours); mating presumably occurs at the same time in *A. c. catalina*. All the Dictionary Hill females and the females collected on Cactus 2 Mountain had not yet mated. These data are consistent with the theory of hilltopping as a mechanism facilitating mating success in low density, widely dispersed lepidopteran populations (Shields, 1967).

While a foodplant for both *A. c. catalina* and *A. s. gunderi* has finally been determined, I suspect that each utilizes additional members of the Brassicaceae. *A. s. gunderi* may well be found on other hosts in the moister environments not frequented by *A. c. catalina*, e.g. the lower slopes and canyon bottoms (see below). *A. c. catalina* may also utilize *Thelypodium lasiophyllum* (H. & A.) Greene, as this plant is common on Catalina Island (Thorne, 1967) and is used extensively on the mainland as a larval host by *A. c. cethura* (J. Emmel, pers. comm.). Meadows (1936) gives no hostplant records for either *Anthocharis* species, but Comstock & Dammers (1932) list the following hosts for a mainland population of *A. c. cethura* in the vicinity of Phelan, California: *Streptanthella longirostris* (Wats.) Rydb., *Caulanthus inflatus* (Greene) Wats., *Descurainea* spp., and *Sisymbrium* (in lab). John Emmel (pers. comm.) has taken *A. c. cethura* larvae on *Caulanthus cooperi* (Wats.) Pays and *Thelypodium lasiophyllum* at several southern California localities. Opler (1967) lists the following hosts for various mainland populations of *A. sara: Arabis sparsiflora* Nutt. *arcuata* (Nutt.) Roll., *Barbarea vulgaris* (L.), *Brassica kaber, Descurainea* spp., and *Sisymbrium officinale* (L.) Scop. Emmel & Emmel (1973) include *Dentaria californica* Nutt. and *Sisymbrium pinnatum* (Walt.) Green in addition as hosts for *A. sara*.

During a return trip to Catalina Island in early May 1978, I was able to observe one of the lowland populations of *A. s. gunderi* in the vicinity of Two Harbors (elevation 30 meters). From 1230 to 1255 hours on 13 May, I followed several female *A. s. gunderi* as they flew amongst the weedy roadside vegetation. One female repeatedly flew back to nectar from the yellow blossoms of a *Brassica kaber* plant and attempted oviposition,

despite being blown away by strong, gusting winds. A thorough search of the *Brassica kaber* plants in the immediate area failed to uncover any *Anthocharis* ova or immatures. Nevertheless, I believe that *A. s. gunderi* uses this crucifer as a larval host. Opler (1967) does include *Brassica kaber* in his list of hosts for mainland *A. sara* populations.

One other observation warrants attention. When I returned to Cactus 2 Mountain on 14 May 1978 to search for immatures of these *Anthocharis*, the *Descurainea* had long since set seed and desiccated. Large stands of *Sisymbrium altissimum* had since grown up along the ridge edges and were in full bloom. I searched many *Descurainea* and *Sisymbrium* in vain for immatures for an hour before my stay was abruptly curtailed by an angry boar. If diapause takes place as a pupa (cf. Emmel's observations above), these *Anthocharis* have at best four or five weeks in which to emerge, mate and ovipost, and feed as larvae before their host desiccates. Clearly, the second generation of *A. s. gunderi* must utilize some other crucifer(s) as a larval host(s).

It is interesting that both species utilize the same host at higher elevations on Santa Catalina Island. Whether and to what degree there is interspecific competion for these resources remains unknown; host preference hierarchies are also unknown. Further studies of hostplant relations would provide information useful for assessing the long-term status of these two endemics, and perhaps help explain the altitudinal habitat partitioning observed for these species.

In summary, the Catalina orange-tip is presently secure. There seem to be no major environmental threats to its continued existence on Catalina Island; the butterfly clearly prefers the more disturbed habitats. Since virtually all of the island is now owned, operated, and maintained by the Santa Catalina Island Conservancy as a preserve, there appears to be no future threat to its haunts from commercial development. I hope others will be stimulated to pursue similar studies on the unique endemic fauna and flora of Santa Catalina and the other California Islands.

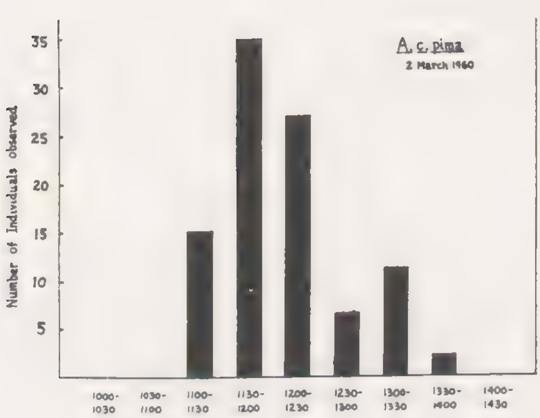

Figure 9: Daily arrival times (Pacific Standard Time) of male *A. c. pima* on "A" Mountain in Arizona. Adapted from Shields (1967).

Acknowledgements

This research would not have been possible without the gracious cooperation of the Santa Catalina Island Conservancy (206 Metropole, Post Office Box 1547, Avalon, California 90704, USA); special thanks are extended to Rose Ellen Potter of this agency. John Emmel, Glenn Gorelick, and Larry Orsak kindly provided editorial advice and information relevant to Catalina's butterfly populations. John H. Thomas and Richard W. Holm (both of Stanford University) provided the plant determinations and editorial and moral support throughout the course of this study. All plant vouchers have been deposited in the Dudley Herbarium of Stanford University. Several preserved ova and a series of three males and one female of *A. c. catalina* have been retained in the author's collection. A fourth male has been deposited in the Peabody Museum of Natural History (Yale University). Travel expenses during 1978 were partially covered by a grant from Stanford University. Lastly, thanks to the Xerces Society and its members for their sustained interest and support for investigations on rare and endangered Lepidoptera.

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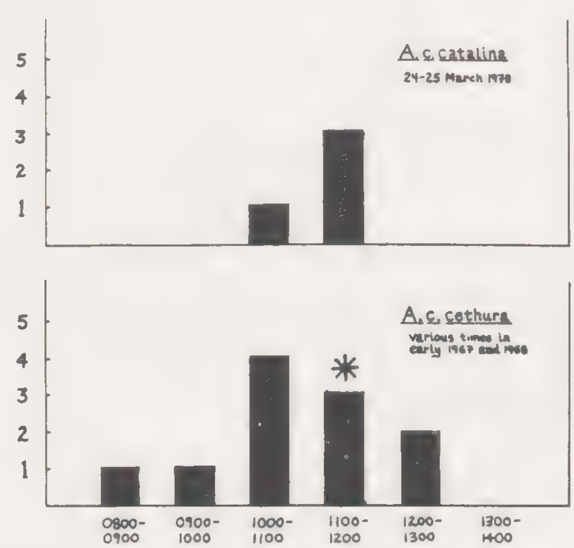

Figure 10: Times of observations (Pacific Standard Time) of female *A. c. cethura* on the summit of Dictionary Hill, San Diego County, California, and on Cactus 2 Mountain, Santa Catalina Island. Observed courtship and copulation is indicated by an asterisk. Adapted in part from Shields & Emmel (1973).

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Appendix: 1980 Observations

On 23 March 1980 I observed several female *A. s. gunderi* in preoviposition activity on young *Sisymbrium altissimum* plants along the north ridge of Cactus 2 Mountain, with oviposition by two different females seen at 1422 and 1433 hours Pacific Standard Time. This *S. altissimum* patch was covered with *Anthocharis* eggs (over 25 on approximately 15 total plants). No female *A. c. catalina* were seen, and the few males taken were quite fresh. Two other *Anthocharis* eggs were also found on *Sisymbrium irio* L. near a roadside in the town of Avalon. The only *Anthocharis* I have ever seen in this lowland area is *A. s. gunderi* (it is common there), and these eggs must belong to that species. Thus, two additional hosts for *A. s. gunderi* have been confirmed.

The butterfly phenology on Catalina Island in 1980 was essentially identical to that in 1978; both years were characterized by unusually high rainfall. However, the plant phenology on the firebreak system in 1980 was no less than a week, and perhaps as much as two or three weeks, retarded over 1978. Notably, the *Descurainea pinnata* on the southwest ridge had barely broken through the soil surface as young seedlings. Several questions regarding host use patterns are raised by these additional observations.

Do these *Anthocharis* select for oviposition whatever crucifer(s) happen to be availabe during their flight season, perhaps responding to a token chemical ovipositional stimulus (glucosinolates?) in these plants? Non-native crucifers are known to be not only suitable—but sometimes *preferred*—female ovipositional substrates, even though the consequence of oviposition is subsequent massive larval mortality (Chew, 1974, 1975). The abundance of *Anthocharis* eggs in 1980 on *Sisymbrium altissimum*, an introduced weed, and the lack of immatures on the same plant in 1978 (although admittedly in different microhabitats), are especially notable.

Should *Callosamia securifera* (Lepidoptera: Saturniidae) Be Protected?

Richard S. Peigler

303 Shannon Drive, Greenville, South Carolina 29615, USA

Abstract

Although the beautiful moth *Callosamia securifera* has been known for over a century, the ecology of the species is still obscure. With a very restricted range and biotope, the moth could become extinct if present trends in human activities continue in the places where *C. securifera* occurs.

Predation and parasitism are important natural controls. However, populations of *C. securifera* are being reduced by agricultural and forestry practices as well as by clearing of land for buildings and roads. Over-collecting of cocoons by lepidopterists and spraying of pesticides may contribute to significant population decline in the future. Two Saturnine moths in Europe are protected by law; perhaps this North American species should be given similar consideration.

Introduction

One of the most beautiful of our large, wild North American silkmoths is *Callosamia securifera* (Maassen). The yellow-suffused males and light orange females are uniquely colored Although now described for over a century (Maassen & Weymer, 1873), the insect remains poorly known. In his excellent treatment of North American Saturniidae, Ferguson (1972) has finally provided a modern treatment of the species including superb color figures. Like other amateur researchers of saturniids, I am trying to build on our knowledge of these moths using the firm basis that Ferguson's work provides. Thus, after making various field and laboratory investigations on *C. securifera* for several years, it is my purpose here to suggest that this species could easily become endangered if no steps are taken toward its protection. My reasoning goes beyond the restricted range and biotope, although these two limitations on the moth are of foremost importance.

Range and Biotope

In an earlier paper (Peigler, 1975) I have given all known locality data for this moth along with a map showing the known and possible geographical distribution. Since publication of that paper, cocoons have been found by J. Wm. McCord in a third county of South Carolina (Dorchester County about 2 kilometers west of Summerville). This is only a minor range extension from the larger population in nearby Berkeley County, a few kilometers to the north. My sporadic sampling all along the Atlantic coastal areas from North Carolina to Florida leads me to believe that the populations in South Carolina and North Carolina are probably disjunct from each other and the main stronghold of the moth to the south. If such is the case, there can be little doubt that human activity has divided the range of the moth.

The westward range in the Gulf Coast area needs much more elucidation. A great amount of southern Louisiana has been converted to agricultural land and it is my impression that southeastern Texas would offer a better habitat for this moth. Although it is not known west of Mississippi, a continuing search for the species in Louisiana and Texas is underway.

The biotope of *C. securifera* is also quite limited. The caterpillar feeds only on Sweetbay (*Magnolia virginiana* L.) (Fig. 2) and this tree is limited mainly to moist coastal plains. The situation is similar to that of the saturniid *Hyalophora columbia* (S. I. Smith) which likewise depends largely on a single host, namely Tamarack (*Larix laricina* (DuRoi) K. Koch), which has a specific habitat, namely bogs. Such moths dependent on single host-plant species which grow only in specific areas are obviously more vulnerable to extinction than broadly adapted moths of the same family such as *Hyalophora cecropia* (L.) and *Antheraea polyphemus* (Cramer). I shall point out below some human activities which eliminate stands of the foodplant of *C. securifera*, thus directly reducing populations of the moth itself.

Natural Controls and Ecology

As in almost all Lepidoptera, *C. securifera* populations are limited by predators, parasites, pathogens, and climate. Climatic factors such as very severe freezing might kill some *C. securifera* since the species occupies areas characterized by a mild climate. These same areas are subject to occasional ravages of hurricanes which occasionally damage host trees.

The parasitoids attacking *C. securifera* are the same ones found in other moths of the same family and particularly the same genus (Peigler, 1977). Parasitism occurs at a level sufficient to be considered a substantial population control.

Avian predation is probably significant for both larvae and adults. I have rarely seen bird damage to cocoons. Larvae are well camouflaged when mature (Brown, 1972) but younger larvae less so. Predators such as spiders and certain insects kill some larvae.

Adult males of *C. securifera*, being diurnal, are particularly vulnerable to attack by Bluejays (*Cyanocitta cristata* (L.)) when visiting females emitting sex pheromones. the late R. B. Dominick told me of these birds swooping down from trees to catch moths which arrived, and returning to their perches to await more arrivals. Males of *C. securifera* and *C. promethea* (Drury) are suspected Batesian mimics of the papilionid butterflies *Battus philenor* (L.) and *B. polydamas* (L.) (Waldbauer & Sternburg, 1976). The brown and yellow colora-

Figure 1: *Callosamia securifera*, male (above) and female. A photograph of Maassen's original figure. Photo by Allan Watson, British Museum (Natural History).

tion of *C. securifera* is similar to that of *Papilio palamedes* L. which is largely sympatric (the larva also feeds on Ssweetbay) and probably belongs to the same mimicry complex. Possibly the toxic models (*B. philenor* and *B. polydamas*) are not numerous enough in some localities for the mimics to derive much benefit.

Although very closely related to its two congeners (*C. angulifera* (Walker) and *C. promethea*), *C. securifera* has a much smaller distribution; this is partly the result of the host-plant, but Sweetbay has a much wider range than the moth. *Callosamia angulifera* is also host-specific (on Tuliptree, *Liriodendron tulipifera* L.) but its host tree is widely distributed northward and inland, and the moth appears to be found anywhere Tuliptree grows in some abundance. The cutting of Tuliptrees in Illinois and Michigan has decreased the northwestern range of this moth according to several lepidopterists. *Callosamia promethea* utilizes several widely distributed host trees, but it too has been eliminated from parts of its northern range where previously abundant (Hessel, 1976). Interestingly, *C. promethea* was believed to have a host-specific population on Horsesugar (*Symplocos tinctoria* (L.) L'Her.) in coastal South Carolina but my colleague J. Wm. McCord and I have found cocoons of this species in that area on Sassafras (*Sassafras albidum* (Nutt.) Nees.), Sweetgum (*Liquidambar styraciflua* L.), Buttonbush (*Cephalanthus occidentalis* L.) and Wild Black Cherry (*Prunus serotina* Ehrhart). If populations of *C. angulifera* and *C. promethea* are disappearing, what does the future hold for *C. securifera*?

Populations of *Callosamia* fluctuate and/or move around over periods of a few years. For the past six winters I have been monitoring *C. securifera* in western Berkeley County, South Carolina by collecting cocoons. While no valid quantitative data were obtained, discernable trends have been noted. Judging from total numbers of viable cocoons obtained, the population was relatively high only during the winters of 1974-1975 and 1975-1976 (Peigler, 1976).

Pressure by Human Activities

Numerous human activities reduce populations of *Callosamia securifera*, either directly or by diminishing the host tree and the amount of habitat. Some of these will be briefly discussed below.

Probably the most significant threat to the moth is reduction of its habitat by recreation and land development. One needs only to make occasional trips to Florida (the state which contains most of the moth's range) to see the rapid destruction. Swamps are drained and filled; forests are cleared. All this is being done to accommodate the increasing tourist and retiring immigrant population of the State. Other states are also experiencing development in the same areas where *C. securifera* lives. Artificial lakes now cover large areas that were once suitable biotope, such as Lake Moultrie in South Carolina.

Forest management appears to be doing more harm than good in preserving this moth. My remarks here refer particularly to Brunswick County, North Carolina and Charleston and Berkeley Counties, South Carolina — the main localities for *C. securifera* in these states. Pines for pulp wood are planted over large tracts of land. Eventually Sweetbay appears beneath these pines and *C. securifera* again has suitable habitat. Then the land is completely cleared when the pines are large enough for harvest, and replanted. In the Francis Marion National Forest it is a routine practice to burn broadleafed plants (including Sweetbay) below the tall pines to favor growth of the latter. I have found cocoons in very small numbers or not at all in these areas. Evidently the moth is better able to maintain populations in areas left untouched by man for longer periods such as where Red Maples (*Acer rubrum* L.) and Oaks (*Quercus* spp.) have reached maturity.

Agriculture threatens the existence of *C. securifera* on a vast scale. The major crops in the Southeast, such as Soybeans, Cotton, and Tobacco, are heavily sprayed with insecticides. These can be detrimental to non-target insects in nearby uncultivated areas. In addition, I have noted herbicide damage to Sweetbay trees in Berkeley County.

Figure 2: Cocoon of *Callosamia securifera* hanging on the nost plant, Sweetbay (*Magnolia virginiana* L.). Drawn by the author.

Spraying of forests if and when the Gypsy Moth (*Lymantria dispar* (L.), Lymantriidae) becomes established in these areas could severely threaten many local Lepidoptera. One control of the gypsy moth is the use of sprays containing strains of *Bacillus thuringiensis* Berliner, a pathogen which kills a wide range of Lepidopterous larvae. Yet these sprays are praised by economic entomologists as being harmless to the environment.

Collecting cocoons of this species by lepidopterists may eventually be cause for concern. Pyle (1975) suggested that humans may locally deplete Saturnines having large, easily found cocoons, such as *Samia cynthia* (Drury). When I have found fair numbers of cocoons of *C. securifera* I have undoubtedly reduced the moth population, but not significantly since I have only collected along roadsides for the most part. However, a lepidopterist living in a moth population center and having much time to collect systematically could probably significantly reduce the numbers in that area within a few winters.

Protection

Although the natural controls which I have outlined keep populations of *C. securifera* in check, some additional major "controls" by man are coming into play at an increasing rate. When one considers these threats collectively, one sees there is cause for concern. I would presently consider *C. securifera* to be a threatened species but not yet an endangered one. But do our moths and butterflies have to become endangered before we take steps?

Wexler (1974) has pointed out that Saturniidae are being alarmingly reduced around the world. I know of only two species which are protected by law. *Saturnia pyri* (Schiffermueller) is protected in the Federal German Republic (Harald Schreiber, personal communication) but the main range of this species is in more southern areas of Europe. Claude Lemaire informed me that *Graellsia isabellae galliaegloria* Oberthur is protected in France. This moth has a very limited range (the French Alps) and is rather host-specific on Scots Pine (*Pinus sylvestris* L.). Perhaps we should begin with our American species such as *C. securifera* and *H. columbia*. To be effective, any measures would have to address habitat protection first; restriction of cocoon collecting might be a secondary consideration.

Acknowledgements

I thank Julian P. Donahue, Los Angeles County Museum of Natural History, for reviewing the manuscript and offering helpful suggestions. Credit must be given here to John William McCord for his help in field observations and collecting of all three species of *Callosamia*.

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Apteraliplus parvulus Roberts (Coleoptera: Haliplidae), An Obscure and Possibly Endangered Beetle

Clifford Y. Kitayama

Division of Biological Control, University of California, 1050 San Pablo Avenue, Albany, California 94706, USA

Abstract

The haliplid beetle *Apteraliplus parvulus* Roberts, known previously only from sites in Washington and California, USA, is now known only from Lake Lagunita, Stanford University, Santa Clara County, California, USA. This artificial lake is subject to major habitat modification. The effects of these modifications on the long-term survival of the species are discussed.

Introduction

Apteraliplus parvulus (Fig. 1) was described as *Brychius parvulus* by Roberts (1913) from one specimen. Chandler (1943) placed it in a new monotypic genus *Apteraliplus*. Hatch (1944) described *Haliplus wallisi*, which was later made a synonym of *Apteraliplus parvulus* (Hatch, 1953).

Figure 1: The haliplid water beetle *Apteraliplus parvulus*. Length ranges from 1.87-2.13 millimeters; width, from 0.93-1.07 millimeters (n=6). Photograph by L. Orsak. Specimen from collection of K. S. Hagen, University of California, Berkeley.

Figure 2: Disjunct distribution of *Apteraliplus parvulus*. Closed circles indicate collection sites.

Originally, *Apteraliplus* had a disjunct distribution. It was recorded from Lake Lagunita on the Stanford University campus at Palo Alto, Santa Clara County, California (collection records from 1913 to 1975), Upper Grand Coulee, Steamboat Rock, Washington (30 April 1939), Upper Grand Coulee, Washington (21 April 1938), and Blue Lake, Lincoln County, Washington (1 May 1938) (Fig. 2). Specimens from the Washington localities have not been recorded since Melville Hatch reported them as *H. wallisi* in 1944. I looked without success in 1975. There may be many reasons or combinations thereof for their later scarcity or possible extinction from Washington. One major habitat change that may be responsible for the demise of the Washington population is the Grand Coulee irrigation project. Thus, Lake Lagunita (Fig. 3) in Palo Alto may be its last refuge.

Present Habitat and Status

Lake Lagunita is artificial, approximately ten acres in surface area at maximum capacity. It is formed by a 609.6 meter (2000 foot) earthen dam ranging from zero to 6.096 meters (20 feet) in height. During years of normal rainfall, it is filled by a combination open flume and an underground pipe which conveys water from Searsville Lake, another artificial lake on Stanford University lands. The original purpose of Lake Lagunita was to serve as a percolation site to replenish the water table from which Leland Stanford, and later the University,

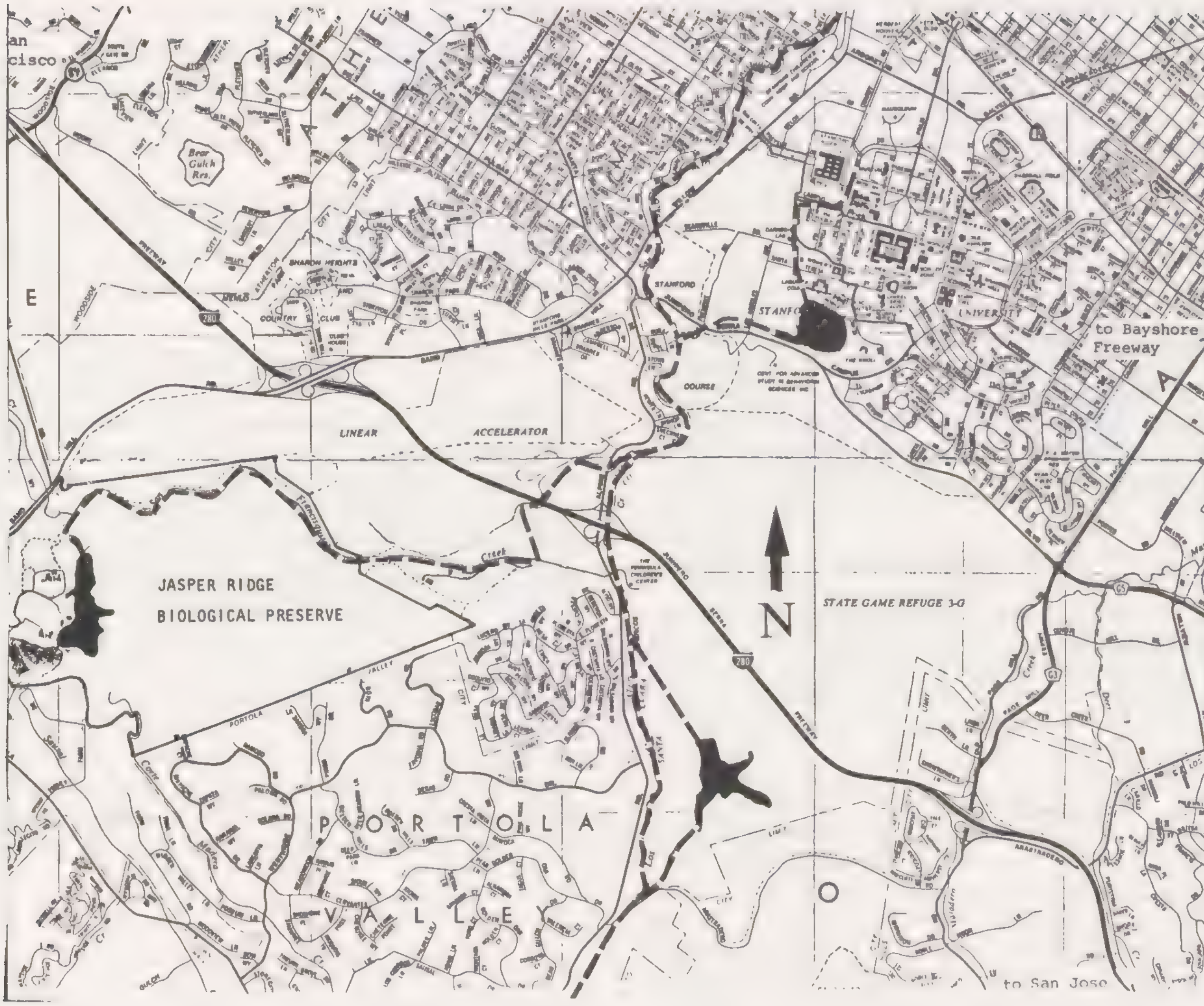

Figure 3: Map of Stanford University area, showing Lake Lagunita (arrow, right) and Searsville Lake (arrow, left). Dotted lines indicate major drainage routes. Jasper Ridge Biological Preserve at left is habitat for a checkerspot butterfly subspecies (*Euphydryas editha* ssp.) soon to be proposed for Endangered species status by Paul R. Ehrlich (Stanford, California).

obtained potable water from a series of wells. In the last thirty years the water table has dropped consistently; at the same time, the demand for water has risen. Stanford no longer depends upon these wells or Lake Lagunita for its water. When the lake can be filled, its current purpose is recreation. Lake Lagunita, along with Searsville Lake, was apparently created between the years 1865 and 1880 when the landowners who preceded Senator Stanford were developing an elaborate water storage and distribution system; Lake Lagunita is shown on survey maps dated 1880.

The drainage system containing Lake Lagunita originates in the Coast Range and extends east toward the south end of San Francisco Bay, a distance of approximately fifteen miles.

Since its creation, the lake has had many disturbances including normal seasonal fluctuations. In years of normal rainfall the lake fills during the winter months and dries up in the late summer. If it does not dry up due to a wet season, it is nevertheless drained in late autumn to accomodate the annual "Big Game" bonfire and rally for the University of California, Berkeley versus Stanford University football game. At this time, the weeds are cleared from the lake bottom and during the festivities, the lake bottom is extensively trampled.

The life history and biology of *Apteraliplus* is poorly known. It appears as an adult during the winter months (December through February) in small puddles and pools at the edge of the reservoir. *Apteraliplus* is most abundant at this time, although it can also be collected into the summer months. Because the lake does dry up and the adults appear immediately after the appearance of water, it is probable that the beetle aestivates as either a pupa or adult buried in the soil. The immature stages are unknown.

The dispersal of the species would appear to be very limited because the adults, as the name (Aptera-) indicates, are wingless. The adults can swim well but as is typical for the family, they appear best adapted for calm water. Therefore, dispersion would only be in a downstream direction toward San Francisco Bay, unless there was accidental dispersion (for example, the eggs might be carried in mud on the feet of wildfowl, shorebirds and mammals).

Since the beetle appears to be very limited in distribution and its dispersive capabilities are limited, habitat management of Lake Lagunita may be critical to the survival of the species. An in-depth study would be necessary to determine the best course of action as this situation is quite unique. In Washington, it appears that habitat alteration was the cause of extinction of the population. However, Lake Lagunita is an artificial lake with a history of frequent disturbances and with environmental factors which apparently create an excellent habitat, as the species is quite abundant in this one habitat.

Another question arises concerning this situation. If it can be determined that this species is a relict population nearing extinction, that can only survive by artificial manipulations of its habitat, is it right to do so? It is a natural course of evolution that species eventually become extinct or undergo adaptations to new environments. However, since human impact frequently disrupts otherwise well adapted species, a response may be to impose additional manipulation in order to conserve natural diversity.

Acknowledgments

I would like to thank Larry Orsak (Berkeley, California) for his criticisms and Oscar F. Nelson, Jr. (Stanford, California) for his information on the history of Lake Lagunita.

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Appendix

Since this paper was submitted, one specimen was located in the collection of the California Department of Food and Agriculture (Sacramento). The specimen label reads: Stanislaus Co., 5 mi. N. Turlock Lake, N.W. of LaGrange, 11 March 76, P. G. & E. Power Plant site. This is an interior central California record. The site has not yet been revisited to confirm the presence of an *Apteraliplus* population.

The Oxen Pond Botanic Park as a Reserve for Common Native Butterflies

Bernard S. Jackson

Oxen Pond Botanic Park, Memorial University of Newfoundland, St. John's, Newfoundland, Canada A1C 5S7

Abstract

Oxen Pond: A major regional botanic garden in Newfoundland is managed primarily for native plants of the province, but also for diversity of other life forms including butterflies. The characteristics of the Park are described along with the methods and successes in butterfly management. Hostplant and nectar source relationships are discussed in relation to their provision for the butterflies of the Park. Philosophy and technique of public attitude and awareness raising, through the medium of butterflies, come under discussion. The natural history and needs of butterflies indigenous to the area are briefly examined, as well as natural limiting factors for the small but interesting fauna. Recommendations given pertain to managing near-urban semi-wildlands in a mosaic pattern in order to maximize diversity, abundance and experience.

Introduction

Oxen Pond Botanic Park is situated in the suburbs of St. John's, capital of the Province of Newfoundland and Labrador, Canada. It is owned and financed by the Memorial University of Newfoundland, and is within a mile, as the crow flies, of the main campus.

The original objective of the project was to create an establishment where representatives of all the major plant groups known to the province could be grown and exhibited in as near a natural habitat as possible. After some preliminary planning, which commenced in the spring of 1971, this objective, though still paramount, was broadened to include interpretation and enjoyment of the Newfoundland and Labrador flora, fauna, and environment in general. This broadening of goals resulted from two factors: firstly, a recognition that the need for such an area existed and secondly, the realization that the control of such a large area (approximately 34 ha. (85 acres)) adjacent to the province's major populace, brought with it the responsibility to consider all forms of life living within the area, irrespective of which may be of dominant interest.

It can be safely stated that the area is now first and foremost a botanic park and secondly a nature reserve. The marrying together of the two philosophies and modes of management creates an ideal medium for teaching a public awareness for nature in general.

The park's involvement with butterflies came about partly because of my own personal interest in these creatures, but mainly because of the recognition of their value as a medium for conservation education. Few people fail to respond to beauty in some form or another. I believe it is this trait, rather than a deep ecological concern, that motivates the average urban dweller to support organized efforts toward nature conservation. Encourage someone's association with beautiful natural things in an attractive outdoor setting, and you encourage the development of a conservationist. Butterflies are beautiful. Present them to the public in association with colourful flowers and you not only kindle a sense of value for these two life forms, but also for the natural world as a whole. If, by exhibiting live butterflies and flowers, we can encourage public support for a diversity of conservation efforts, so much the better. Added to this, visitors display a keen interest in the welfare of the butterflies themselves. We are determined to play our part in ensuring that there will always be a place where these interesting creatures can fly free.

Of the twenty-five species of butterflies recorded with the Park's boundaries, all but five, the Monarch (*Danaus plexippus* L.), the Hop Merchant (*Polygonia comma* (Harris)), the Compton Tortoise Shell (*Nymphalis vau-album* D. & S.), the Common or Clouded Sulphur (*Colias philodice* Godt.) and the American Painted Lady (*Vanessa virginiensis* Dru.), have probably bred here at one time or another. Of the twenty breeding species, all but the Red Admiral (*Vanessa atalanta* L.) and the Painted Lady (*Vanessa cardui* L.) are resident throughout the year.

General Description of Area

Land within the botanic park is undulating, and has good topographic and environmental variety. When we acquired the area the main habitats included mature and regenerating Balsam Fir (*Abies balsamea* (L.) Mill.) and spruce (*Picea marina* (Mill.) BSP. and *P. glauca* (Moench) Voss) forest, bog and fen, heathland, Mountain Alder (*Alnus crispa* (Ait). Pursh) thicket, exposed rock outcrop, lake margin, and a large expanse of burnt-over forest. The forest was burned ten years prior to our taking over the area in 1971. Regeneration has been mainly with the deciduous shrubs, Pin Cherry (*Prunus pennsylvanica* L. f.), Wild Raisin (*Viburnum cassinoides* L.), and dogberry (*Sorbus americana* Marsh. and *S. decora* (Sarg.) C. K. Schneider), along with a variety of herbs and other small plants. There was a marked absence of deciduous trees, brought about by traditional harvesting for fuel wood. A few clumps of White Birch (*Betula papyrifera* Marsh.) are now becoming established from sprouted stumps and self-sown seed.

Due to the undulating nature of the park, the land varies between 134 and 156 m (440-510 ft.) above sea level. The park is within four miles of the Atlantic Ocean. Our weather is greatly influenced by this close proximity to the sea. Generally speaking the park experiences much milder winters and cooler

summers than most of the major populated areas of Canada. Sea ice, from the North, is a controlling factor as far as spring temperature is concerned; consolidating near the coast, the ice-flows effectively retard spring and shorten the vegetative growing season to approximately 160 days. This is probably one of the main reasons why butterflies that normally have two or three generations per year elsewhere, only manage to produce one in our area.

At the nearby St. John's airport, with an elevation of 141 m (463 ft.) above sea level, the lowest average monthly temperature occurs in February at -4.7°C (23°F), while the highest average monthly temperature is in August at 15.4°C (59.8°F). The airport's annual average total hours of sun is 1,435; the Park possibly has a little over this amount of sunshine.

The average annual precipitation is 150 cm (59.20 inches), 24% as snow. The mean annual potential evaportranspiration is 47 cm (18-19 inches), leaving a moisture surplus of approximately 103 cm (40 inches). Much of this rain comes during winter, early spring and in the fall, causing a potential for overwintering adult butterflies to be affected by molds and mildews, and for early and late butterflies, fewer available hours for nectar-gathering. In a wet September, large numbers of Mourning Cloaks (*Nymphalis antiopa* L.) will suddenly disappear; whether to hibernate early, or die, I have not been able to determine.

Our prevailing winds are from the west (26%) and Southwest (21%), the latter being most frequent in summer. A calm day is a rarity in Newfoundland. Butterflies are seen being buffeted and swept along, apparently out of control, or labourously flying close to the ground, seemingly making very little headway. The provision of shelter from this almost ever-present wind is one of our prime considerations in the management of both plants and butterflies.

Any natural soil in the park is rocky, acidic, nutrient-poor and barely a few inches deep. There are however a few small pockets where the earth may be as much as a foot in depth. In management, this soil may be left as is, or modified to suit the desired plant type.

Aims and Methods

It must be understood from the very start that, in our management attempts, we are dealing solely with relatively common butterflies in an area that has been utilized and modified by man for generations. Were we to be dealing with less common, or rare species, in a more pristine setting, our attitudes and philosophy would probably be totally different. Also, we are only interested in encouraging our own, indigenous butterflies. There are, however, native species not already present in the park that one day we may wish to introduce. Such introductions would only be attempted with stock from the local gene pool; we are in no way interested in encouraging species from outside the province, unless they arrive unsolicited from natural causes.

We are well aware that the management of any life form should first be backed up by detailed, sound research. This would be particularly important in any attempts to manage uncommon, less mobile species such as the Dorcas Copper (*Lycaena dorcas* Kby.), which is not present in the Park. In Newfoundland, it seems to be tied to a very few special areas, even though there are thousands of apparently similar sites available to them.

Certain species in the Park are restricted to small, fairly precise areas and for these little management is knowingly undertaken. The Jutta Arctic (*Oeneis jutta terrae-novae* dos P.) and the Bog Copper (*Lycaena epixanthe phaedrus* Hall) are examples. Others, for instance the Brown Elfin (*Callophrys augustinus* West) and the Arctic Skipper (*Carterocephalus palaemon* Pall.) appear to be more mobile, yet are only present in small numbers. It is my hope that sometime in the not too distant future the funds and suitable personnel can be found to investigate these species, either within our Park or throughout Newfoundland as a whole.

I believe that in considering the mobile, common, "backyard" butterflies, there is much basic management that can be undertaken to increase their popultion density, or to induce them to settle in a particular area. Given a good sized gravel pit, money and time, it would not be too difficult to create an exhibit of free flying "backyard" butterflies. It is fortunate that many of the most common butterflies are also among the most beautiful. In our work, this is important. We can accomplish far more by showing a Red Admiral sunning on a Strawflower (*Helichrysum bracteatum*), than we would were we able to show a rare but subtle prairie skipper in its native habitat.

It should be remembered that our primary concern is with the creation of near-natural habitats for native plant species. How fortunate it is that the demands of many butterflies and plants are so similar and that butterflies are so closely tied to native flora. How sad it is that more botanic parks or gardens do not realize this, and act accordingly.

To produce butterflies in a botanic park, or indeed, to create and run a botanic park primarily for indigenous plant species, calls for an overall philosphy very different from the norm. Many orthodox ideas, values and methods are of small worth; unorthodox thinking must prevail. In thinking, planning, and working with both plants and butterflies, it is often very difficult to divorce one from the other. Fortunately the two go so well together that there is very little conflict. If one is already developing an area for native plant species, it often takes very little extra consideration, or money, to take the matter a step or two further, for the benefit of butterflies.

There are a few basic philosophies that we believe are important and that need to be continuously born in mind. We create as much habitat diversity as possible, and shall continue to do so, for many years to come. In speaking of "habitats", I am not necessarily implying the creation of large, natural sites. Our Park is split up into two basic sections; a large natural area and a smaller, semi-formal area. In the semi-formal, or suburban garden-type area, a flower bed or a piece of uncut grass is considered a habitat. In striving for diversity we have created such minor sites as a 40 X 2 m rough bankside and a 10 X 5 m mud hole. In creating habitat diversity we strive to form a mosaic of smaller, irregular sections, rather than large, uniform blocks. In doing this we try to see that as many sections as possible are sheltered from wind and that there are innumerable sun pockets available.

In working with naturalistic parks, and people, one must always fight a tendency to be overly neat and tidy. Tidiness creates formality, formality induces sterility. A tidy, well kept garden is often quite devoid of wildlife. A rotten branch with an old woodpecker hole may shelter a Mourning Cloak; a pile of rocks, a Milbert's Tortoise Shell (*Nymphalis milberti viola* dos P.).

Generally speaking, there is very little place for chemical pesticides in our work. This comment may startle the horticulturists. In our area the only poisons that are used are a few slug pellets around valuable alpines and in the vegetable garden. Were we to take chemical steps to combat every type of insect damage in our area, we would soon be wading knee deep in noxious fluids! A diversity of small habitats, carefully intermixed with each other, encourages a diverse and healthy fauna. The use of this basic ecological principle has so far protected us from any serious insect problems.

Another problem that could arise is caused by the tendency to classify forms of life as good or bad. There is a very real danger of slipping into the habit of protecting organisms one likes (e. g. butterflies) and destroying others (e. g. spiders). We consciously strive to maintain a philosophical attitude toward all forms of life inhabiting our park. Sadly, we are not always successful. I must confess that there have been occasions when I've seen a butterfly hit a spider's web, and quickly hooked it out before the spider reached it.!

Unfortunately, when working with public funds there is always pressure to produce something obvious and showy. Given the necessary funds, this can easily be accomplished in an orthodox botanical garden or city park. When working to create a natural area however, the whole idea is to make each exhibit look as if it has always been there. An uninformed visitor to an area such as ours may notice little of obvious creation and believe, therefore, that little has been accomplished. We try to create natural-appearing sites, and hope they fool visitors into believing that they were not man-made, but naturally evolved.

The Semi-Formal Area

This area is approximately three acres in size and is being created from a piece of previously disturbed land, adjacent to a public highway. It contains our Headquarters building (Field Centre) and the manager's residence. This is the area we consider our butterfly garden. (The wilder section of the Park is more a "reserve".) It is here that we are creating a "jigsaw" effect of remnant pieces of natural vegetation, manufactured flower beds and walkways.

Plant beds include a rock garden, peat beds, heather garden, perennial border, cottage garden, vegetable garden, and an area for garden flowers of old Newfoundland. The perennial border and cottage garden are specifically planted and maintained to attract butterflies and other pollinating insects. Other gardens, though not planted specifically for butterflies, nevertheless contain many plants that are useful for this purpose.

Since this is the area that attracts most of our visiting public, especially the more elderly members, it is fortunate that it is here that the largest and most varied numbers of butterflies can be seen. Its main value for butterflies is its diversity of nectar sources, its numbers of host plants, and its mixture of light and shade providing an apparently unlimited number of sunning and resting sites, sheltered from the wind.

The Naturalistic Area

This is by far the larger area of the park. It is visited only by those members of the public interested in quiet walks or nature study. A system of trails has been provided; they are maintained in a primitive manner. As elsewhere in the Park, no vehicles are permitted and visitors must keep to designated footpaths. Since the Park is also a nature reserve where a sense of peace and solitude is a valuable asset, no dogs (other than seeing-eye dogs) nor any forms of noise makers, are permitted. These and other park regulations are enforced from May to mid-October by a patrolman continuously walking the area during our busiest hours, with radio contact to our headquarters.

Habitats here are managed, or created, in larger blocks. A mosaic effect is attempted by varying their shape and sizes, and by occasionally allowing small, unrelated areas of vegetation to remain within a more major habitat type. We are further considering the breaking up of certain adjoining forest habitats by the use of 7-10 m wide trails, made up of a central walking trail with a ribbon of shrubs and herbs on either side (similar to the "rides" of English nature reserves).

Once decided upon, the major habitats throughout the Park will be maintained as such and will not be permitted to change through succession. Though we are primarily managing native flora here, any indigenous butterfly species associated with a particular habitat type will also be considered, and so, we hope, will be able to maintain its presence on the site.

Nectar Sources

The provision of a plentiful and varied supply of nectar is our main method of inducing unusually high numbers of butterflies to congregate in areas of high public utilization. This technique is also the quickest and easiest way for the enthusiast to encourage these beautiful insects to visit the home garden. Heal (1973) has found that available nectar is a serious limiting factor in butterfly gardening, especially late in the season. A problem in offering, or receiving recommendations for potentially useful flower types, lies in the fact that a species of flower may bloom at different times in different locations. Also, butterflies may not be on the wing at similar seasons in all areas. Granted the variation may be slight in either case, but it may nevertheless be sufficient to defeat the necessary synchronization. We have found that some of the flowers of proven value for attracting British butterflies are of no value to us, simply because they bloom at a time when we have nothing on the wing that will utilize them. It is my contention that the butterfly gardener is dependent mainly on members of the Nymphalidae. It is fortunate that this family provides some of the most beautiful and, in my experience, the most easily managed butterflies in our fauna. It is certainly far easier to "pull" a Red Admiral into your garden than it is a Brown Elfin, even when the latter is living close by.

In the Park we grow a variety of ornamental annual, biennial and perennial flowers solely to attract butterflies and other pollinating insects. When we find a useful plant, we normally continue to grow it year after year. Whenever we hear of a potentially useful plant that may grow in our area (Horticultural Plant Zone 5B Canadian. 6 U.S.A.) we try it. We keep records of the flowers that are utilized by each species of butterfly. After a good many years of gardening for butterflies I have come to the conclusion that, except for a very few exotic ornamentals, one should concentrate his or her efforts on identifying and then cultivating native nectar sources within the garden setting. If having a colourful garden is an important consideration, then there are many exotic ornamentals of lesser value that can be used. But, if your interest is butterflies, first and foremost, then work with predominantly native or naturalized flora.

We are particularly dependent on native or naturalized plant species to provide nectar for early spring butterflies and for

those species that have overwintered as adults. Willows (*Salix* spp., especially the Pussy Willow (*S. discolor* Muhl)), Leatherleaf (*Chamaedaphne calyculata* (L.) Moench) and Dandelion (*Taraxacum officinale* Weber), are particularly useful. The only really useful, early flowering exotics we have are cultivars of the native Rock-cress (*Arabis alpina* "Grandiflora" and *A. a.* "Rosea") and the heather, *Erica carnea* "King George".

The main and most obvious butterfly season in the Park comes in the late summer and fall, when the flowerbeds are full and when the newly emerged Nymphalidae are on the wing. Useful exotic flowers at this time include the following: Cone Flower (*Rudbeckia* vars.), Floss Flower (*Ageratum houstonianum* "Blue Mink"), Straw Flower (*Helichrysum bracteatum*), Sweet William (*Dianthus barbatus* "Wee Willie"), Bouncing Bet (*Saponaria officinalis*), Fall Phlox (*Phlox paniculata* vars.), Showy Sedum (*Sedum spectabile*), Siberian Wallflower (*Cheiranthus allionii*) and the single French Marigold (*Tagetes patula* "Naughty Marietta"). The latter proves particularly useful for us. Generally speaking, when working with garden ornamentals, remember that the old fashioned single flower types are best; many of the modern cultivars, though beautiful in themselves, are of no value to butterflies. The famous Butterfly Bush (*Buddleia davidii*), is indeed a great attractant to butterflies, especially members of the Nymphalidae. Two of the only four Monarch Butterflies (*Danaus plexippus* L.) seen in the Park were observed feeding on the variety "Mayford Purple". One of the problems for us in growing this beautiful shrub is that it is slow to start growing in spring, so more often than not, does not have time to come into bloom before frosts arrive. It is also difficult to overwinter outside. A few useful native species worthy of the perennial border are Wild Aster (*Aster novibelgii* L.), Spotted Joe-Pye Weed (*Eupatorium maculatum* L.), Lance-Leaved Goldenrod (*Solidago graminifolia* (L.) Salisbury.), Oxeye Daisy (*Chrysanthemum leucanthemum* L.) and Pearly Everlasting (*Anaphalis margaritacea* (L.) Benth. & Hook.).

The flowers of various types of culinary herbs have been found useful in Britain but so far not for us. However, the Common Chive (*Allium schoenoprasum*) when allowed to flower is used by the Red Admiral, Painted Lady, Milbert's Tortoise Shell and our two swallowtails (*Papilio brevicauda* Saund. and *P. glaucus canadensis* R. & J.). It is also beloved by our Clear-winged Sphinx Moth (*Hemaris thysbe*). If you are interested in bumble bees, be sure to grow *Echium vulgare* "Blue Bedder" or *E. v.* "Dwarf hybrid"; both are very useful in attracting these creatures.

We have done some work in increasing the amount and variety of nectar sources within the naturalistic area of the Park. This is done by planting suitable native plants in areas where butterflies are known to exist, or believed to fly past. We intend soon to experiment in attracting butterflies from one area to another by enticing them along a line of native flowers especially planted for this purpose. One such experiment will attempt to pull Milbert's Tortoise Shells, Red Admirals and Painted Ladies from an area they are known to frequent, on the edge of our boundary, through a dense block of native conifers, to the open area of our new plant nursery. A "homing-in" target at the start of the trapline will be created by planting a block of Alfalfa and Red Clover. Encouraging butterflies along naturalistic walking trails so that they can be more readily viewed by our visitors is also in the plan. This will be attempted once we have sufficient plants on hand in our nursery.

Host Plants

Wherever possible we introduce native plant species, and manage those plants already present that are the known or suspected host plants of indigenous butterflies.

The main host plant of the Canadian Tiger Swallowtail (*Papilio glaucus canadensis* R. & J.) in the Park, and possibly Newfoundland as a whole, appears to be the native Pin Cherry (*Prunus pennsylvanica* L. f.). This plant is associated with burnt-over ground and other disturbed areas. There is a lot of it in the Park at present, but steps will have to be taken in the long-run to stop it being smothered out by conifer regeneration. It requires full sunlight to do well. When we are cutting trails and opening up glades in our forested areas, we clear around some of these trees and, if they are tall and spindly, often cut them down to ground level and let them sprout up again. In this way we often increase the available host food, tenfold. We do this with many deciduous shrubs that have become weak and spindly. Opening up around these plants not only benefits the plant itself, but as the sun streams in, creates a more suitable habitat for butterflies and other small creatures. Wild Raisin (*Viburnum cassioides* L.) is also treated in this manner. The flowers and forming seeds of this shrub provide the main food source for the larvae of our Spring Azure (*Celastrina argiolus pseudargiolus* B. & LeC.).

Two small rough meadows have been created for roadside and meadow flowers. They will, I hope, provide additional habitat for the Park population of Inornate Ringlet (*Coenonymphs inornata* Edw.). Some low shrubs, such as the Blueberry (*Vaccinium angustifolium* Ait.), which is the host plant of the Pink-edged Sulphur (*Colias interior* Scud.), and provides nectar for many bees, will be allowed to stay amongst the grasses. Young trees will be kept in check by annual fall moving. Certain native herbaceous material may be planted in these meadows to provide additional nectar.

Some additional willows (*Salix* spp.) and a few clumps of Balsam Poplar (*Populus balsamifera* L.) and Trembling Aspen (*Populus tremuloides* Michx.) have been planted to provide additional host material for the Mourning Cloak, and also to be ready in case the Compton Tortoise Shell (*Nymphalis vau-album* D. & S.) and the White Admiral (*Limenitis arthemis* Dru) extend their range into our area.

We are trying to induce the Short-tailed Swallowtail to establish in the Park. This is being done by the release of hand-reared adults and larvae gathered in local areas of abundance, and by introducing and growing the necessary host plants. Host plants in Newfoundland include the natives, Cow Parsnip (*Heracleum maximum* Bartram), Angelica (*Angelica atropurpurea* L.), Scotch Lovage (*Ligusticum scothicum* L.), Hemlock-Parsley (*Conioselinum chinense* (L.) Britton, Sternset & Poggenburg) and the alien, Wild Parsnip (*Pastinaca sativa* L.). In the vegetable garden they will breed on carrot, celery, parsley and parsnip. A row of the latter is planted annually, especially for this creature. Local vegetable gardeners are being encouraged not to destroy any such caterpillars they find, but to bring them to me for hand-rearing, or for placement on the few patches of native host plants established within the Park. Establishing a butterfly into an area is slow work, indeed it may be completely impractical; however, the occasional Short-tailed Swallowtail is now seen in the park each year at the appropriate season. In 1977, a female laid eggs on a number of clumps of Gas Plant (*Dictamnus albus*) in our perennial border. So far, I have

not found a published reference to this butterfly using such a plant as a host for its young. One year a female oviposited quite heavily on Wild Chamonile (*Matricaria chamomilla* L.), but the larvae died shortly after emerging.

The main host plant for the Red Admiral and Milbert's Tortoise Shell in our area is undoubtedly the alien Stinging Nettle (*Urtica dioica* L.). This plant is managed in the Park. It is not the sort of plant that one would normally encourage but fortunately it only appears to be able to take over disturbed, enriched ground; not natural woodland and such. Since we brought this plant into the Park our Red Admiral population has climbed considerably. It used to be unusual to see one of these butterflies within our boundaries, yet on one occasion last year I counted seventy-seven on the flower beds, and I must have missed some. Nettles are planted close to the nectar source so that newly emerged imago can quickly find sustenance.

One of the main host plants for the Painted Lady in our area is the Canada Thistle (*Cirsium arvense* (L.) Scopoli). We have some in the Park, but it is not a plant one really wants to encourage. Fortunately, we have found that the Painted Lady, certainly for the past two years, prefers to oviposite on Borage (*Borago officinalis*) and ornamental varieties of the Common Blueweed (*Echium vulgare* L.) in the Park. Last season I had to remove thirty-six large caterpillars off a small clump of Blueweed, which was on a favourite flight path, and place them elsewhere before they starved. These two plants will be grown in the Park annually from now on. The Musk Mallow (*Malva moschata*) has also been used as a host in the Park, but not in any quantity.

Miscellaneous Management

Since the type and quality of soil is of prime consideration in horticulture, it must also be considered in any plans to manage butterflies. As we have already seen, butterflies and plants are so closely associated that anything affecting the plant life of an area will, in one way or another, affect the resident butterflies. Ornamental nectar sources are usually grown in good quality, fertile earth. The creation of such a growing medium may be all right to increase certain native species in the nursery, but it would not do to have a similar permanent site for them. Wild meadows, walkways and rough corners produce and maintain a greater diversity of plant life if the soil is lacking in nutrients. If the earth is rich, the common perennial grasses are inclined to gain dominance and smother out the more desirable plant species. Since our soils have very limited phosphorous, we usually use a dusting of bone meal when setting out new trees and shrubs in the natural area of the Park. Herbaceous material is planted without any nutrient additive.

When we took over the area there were few trails, especially through the dense conifer stands. There were also large areas covered by wind-fallen trees. Most of the windfalls have now been removed, to allow new growth to spring up, and diminish the fire hazard. Unwanted branches and brush are piled or burned. The heavier timber, if not required for lumber, is stacked up in such a manner that rabbits can hide underneath and overwintering butterflies can crawl in amongst the inter-crossing timbers. Piles are placed on edge zones, near sunlight and nectar sources, not well back into the shade. Pole-sized trees are stacked up, wigwam fashion. Forest trails are made to meander through various sections of flora and, where glades are not already present, some are cut at suitable locations. Though we do leave some blocks of dark, impenetrable, conifer regeneration we normally thin out the stands to allow sunlight to enter. In our small area we cannot afford to leave land in a state inhospitable to other flora. By creating trails, forest glades, and dappled sunlight we are, we believe, also improving the area for native butterflies. Hollow trees and branches are left wherever they do not present hazard to our visiting public. Experience with adult Mourning Cloaks and Milbert's Tortoise Shells, and pupae of Tiger Swallowtails, suggests that log piles, hollow trees and pole wigwams may increase the number of available overwintering sites.

Newfoundland is rarely windless. In our semi-formal area we have endeavored to site our flower beds where they can be sheltered from excessive wind. This is accomplished either naturally with a stand of trees or shrubs, or artificially with windbreaks. When planning trails, care is taken to avoid the creation of wind funnels. Future plans for the natural area call for the planting of a mosaic of blocks of native trees. This will eventually lessen the amount and velocity of wind reaching a large area of the Park that is presently quite bleak, and very windswept. This should increase not only the variety and quality of native flora we can grow, but also render certain areas of the Park less inhospitable to butterflies.

It is well known that certain species of butterflies are attracted to damp mud, fermenting fruit, animal excrement, tree sap, urine, tobacco smoke and human perspiration. "Mud puddling", in numbers, though apparently common elsewhere, is very unusual in Newfoundland; as far as I know, only Tiger Swallowtails and Pink-edged Sulphurs have been observed mud puddling here. This behavior has not been observed in the Park. I have briefly tried to draw in butterflies with trays of sand dampened with a saline solution, but could not keep the surface damp for more than a few minutes; a drip or wick of some sort would, I think, be required. I am now going to try vials of saline mix with a cottonwool wick. I have tried this with a honey solution and had some success luring Red Admirals, but more work needs to be done. Domestic fruit trees such as apples are very scarce in Newfoundland, and I have never heard of butterflies being attracted to the fruit of the few that are available. However, a brief experiment with a couple of bruised apples last fall did succeed in attracting Red Admirals. Experiments along these lines may continue. I have two records (one from the Park) of Mourning Cloaks being attracted to the fruit of Dogberry (*Sorbus* spp.), and one record of a single specimen of this species probing damp soil. There is also an observation made in the Park of a Green Comma (*Polygonia faunus* Edw.) probing old dog excrement and the soil immediately adjacent to it. Both the Mourning Cloak and Milbert's Tortoise Shell have been observed feeding from tree sap. I have taken Tiger Swallowtails whilst they were attracted to heavily perspiring labourers, but not in the Park. Whether or not the use of natural or artificial odors can be used in butterfly management remains to be seen. Given the right conditions, the use of a saline mixture has been shown to have great possibilities for attracting Tiger Swallowtails.

Hand Rearing

Some hand rearing of caterpillars collected outside the Park, or brought into us by park visitors, has been, and is, undertaken. So far our efforts have been restricted to our two swallowtails, Milbert's Tortoise Shell, the Mourning Cloak, Red Admiral, Painted Lady and Spring Azure.

Rearing has been undertaken for one or more of the following reasons. To provide live exhibits in our Field Centre, to release adults into the park, or to save caterpillars from destruction elsewhere. Rearing has only been done from eggs or larvae in small cages.

We are now experimenting with an eighteen-foot diameter dome flight cage. Suitable host and nectar producing plants will be grown inside this dome, then the desired adult butterflies or larvae will be released into it. Since the ideal insect cage is yet to be discovered, our dome is experimental. There are many problems involved. However, it is hoped that in trying to solve some of these problems we will have the opportunity to learn much more about our native butterflies and their arthropod predators.

General Comment on the Butterflies of the Park

The Swallowtails (Papilionidae)

Two species are presently found in the Park. They are:
Short-tailed Swallowtail (*Papilio brevicauda* Saund.)
Eastern Tiger Swallowtail (*Papilio glaucus canadensis* R. & J.)

The Tiger Swallowtail is quite common, appearing on the wing during the first or second week of June. It has not been seen in the Park after the end of July. Ovipositing mainly on the native Pin Cherry (*Prunus pennsylvanica* L. f.) it overwinters as a chrysalis. This is one of the only native butterflies that I have seen (though not in the Park) or heard of forming mud-puddle clubs in Newfoundland.

The short-tailed Swallowtail, as discussed earlier, is presently being introduced, and hopefully established, in the area. In Newfoundland it is mainly found along the coast, on offshore islands, or around river estuaries and valleys. It does however enter gardens inland, including some gardens in and around St. John's.

Both species can be attracted to ornamental flower beds, but not as readily as some members of the Nymphalidae.

The Whites and Sulphurs (Pieridae)

Though there are six species from this family recorded from insular Newfoundland, only three have been recorded within the Park. These are:
Pink-edged Sulphur (*Colias interior* Scud.)
Common or Clouded Sulphur (*Colias philodice* Godt.)
European Cabbage Butterfly (*Pieris rapae* L.)

The Pink-edged Sulphur is seen on the wing throughout most of July. It is quite common especially on the open, burnt-over area, where its host plant, the Blueberry (*Vaccinium angustifolium* Ait.) thrives. It has been observed ovipositing on this species growing in the walls of our peat beds. This butterfly is believed to overwinter as a larva. We have not found it attracted to ornamental flowers, but this may simply be due to the positioning of our flower beds in relation to its favoured habitat. It has been observed during hot weather in the Park, probing damp peat blocks.

Apart from leaving quantities of its host plant in the meadows we have created, no form of management of this species has knowingly been undertaken.

The Common Sulphur has only been observed in the Park once; on 10 August 1980. It was feeding from the flowers of Oxeye Daisy, Blue Ageratum and old-fashioned Calendula.

The European Cabbage Butterfly is, of course, common. No attempts to manage it, or seriously deplete its numbers, have been attempted within the Park.

The Monarch (Danaidae)

The Monarch or Milkweed Butterfly (*Danaus plexippus* L.) is not a known breeding resident in Newfoundland. Though it has never been known to oviposite in the province, a mated pair was photographed by a member of the Park's staff in late July 1977 some distance from the Park. There is no Milkweed growing in Newfoundland; there are, however, three species of the genus *Apocynum* which has been observed as an alternate host plant elsewhere. A few sightings are made by observers in Newfoundland most years, usually during late summer and fall. In 1973 one was recorded (September 13) in the Park feeding from the flowers of Rough-stemmed Goldenrod (*Solidago rugosa* Ait.) and two (September 22) on the flowers of Butterfly Bush (*Buddleia davidii* var. Mayford Purple). On June 21, 1980, one was observed making exploratory flights over various flower beds in the Park.

The Satyrs and Wood Nymphs (Satyridae)

Of the five Satyridae recorded from Newfoundland two, possiby three, are found in the Park. The Inornate Ringlet (*Coenonympha inornata* Edw.) is common in grassy areas, appearing on the wing anytime between the second week of June and the end of the first week in July. The colour of these butterflies is very variable and, since we have both very light and very dark forms in the Park, we have been advised that we probably also have the McIsaac's Ringlet (*Coenonympha inornata mcisaaci* dos P.) within our boundaries. Research is needed to establish if this is correct.

The Jutta Arctic (*Oeneis jutta terrae-novae* dos P.) inhabits the Park in small numbers. It is found on our three small pieces of bog and sometimes passing through other open areas. Occasionally it will be seen in open forest sites, perching on trees. It appears on the wing during late June or early July, but its life cycle requires two growing seasons and so is only seen every second summer. Here it flies only on even-numbered years. Try as we may, we cannot locate a single specimen in odd-yeared seasons. It can behave aggressively. In the Park it has been observed to fly up and attack both the Tiger Swallowtail and the Common Skimmer Dragonfly (*Libellula quadrimaculata* L.). Nevertheless it has also been observed allowing itself to be annoyed by both the Inornate Ringlet and the Brown Elfin; both considerably smaller butterflies.

Though the Jutta Arctic is occasionally seen flying through or sunning in our semi-formal area, I have never seen it attracted to any of our non-native ornamentals. The Inornate Ringlet readily frequents the rough grassy patches of our semi-formal area but very rarely visits non-native ornamentals.

We are trying to ensure the continued presence of these Satyridae by planning the continuation of a diversity of grassy sites, and by protecting our bog environment from natural succession and possible outside drainage schemes.

The Brush-Footed Butterflies (Nymphalidae)

Of the twenty Nymphalidae recorded from insular Newfoundland only ten have been seen within the Park boundaries. These are:

Atlantis Fritillary	(*Speyeria atlantis* Edw.)
Pearl Crescent	(*Phyciodes tharos arctica* dos P.)

Green Comma	(*Polygonia faunus* Edw.)
Hop Merchant	(*P. comma* Harris)
Compton Tortoise Shell	(*Nymphalis vau-album* Des.)
Milbert's Tortoise Shell	(*N. milberti viola* dos P.)
Mourning Cloak	(*N. antiopa* L.)
Red Admiral	(*Vanessa atalanta* L.)
American Painted Lady	(*V. virginiensis* Drury)
Painted Lady	(*V. cardui* L.)

The Nymphalidae are the dominant and most visible group of butterflies in the Park. They are colourful, active, easily observed, and respond well to our efforts to attract and show them to the general public.

Of the species recorded, the Hop Merchant, the Pearl Crescent and the Compton Tortoise Shell are the least common. Indeed, we have only recorded the Pearl Crescent once (June 21, 1979) and the Compton Tortoise Shell for twelve days (September 14-26) in 1977. Neither of these butterflies are common on the east coast of the province, indeed the latter is not common anywhere on the island. The Hop Merchant too, has only been observed once. On May 23, 1979, two were recorded on our peat beds; they are the first records of this species for Newfoundland.

The Atlantis Fritillary has been seen in five of the nine years we have been keeping records, but only in August and never more than the odd few specimens. One limiting factor may be a dearth of suitable host plants, i. e., *Viola* spp. We have every intention of rectifying this in the not too distant future.

The Red Admiral has been recorded in the Park every year of the past eight, except in 1974. Earliest reliable record is May 30 and the latest recorded on the wing is November 4. Their numbers in the Park have vastly increased since we developed the flower beds and provided a suitable host plant.

The Painted Lady was not recorded in 1974, 1975, or 1980, whereas the American Painted Lady did not put in an appearance during 1973, 1974, 1975, or 1980. The latter has only been recorded between the dates August 30-October 2, yet the Painted Lady has been seen as early as May 21 and as late as October 24. Up to the present time, approximately eight sightings of the Painted Lady have been made for every one sighting of the American Painted Lady. The latter has never been recorded breeding in Newfoundland, indeed the first record of this species for the province was made in the Park, only as recently as September 11, 1972.

It is not definitely known whether or not the Red Admiral and the Painted Lady overwinter in Newfoundland. I personally feel that small numbers may occasionally overwinter here, but that it is not usual.

Mourning Cloaks are the first butterflies to appear on the wing and have been seen as early as April 10. The latest they've been recorded is October 26. Their preferred host plant in the Park is Willow (*Salix* spp.). Adults of the new generation usually appear during the second half of August, and can, at this time, be seen feeding in the company of Red Admirals, Painted Ladies and Green Commas. Though they will give way to the more aggressive American Painted Lady, I have seen one deliberately walk up to a Red Admiral on a large flower head and physically bump it off the bloom!

The Milbert's Tortoise Shell and the Green Comma also overwinter as adults and appear on the wing during the last week of April. The former is possibly the most common butterfly around the inhabited areas of Newfoundland due largely to the infinity of its host, the European Stinging nettle (*Urtica dioica* L.), with cultivated or otherwise disturbed land. So far we have not located any Green Comma larvae in the Park so cannot say if it has a preferred host. A variety of its host plants occur naturally in the Park, and we are also growing and introducing an additional one, the native Smooth Gooseberry (*Ribes hirtellum* Michx.). The Green Comma is not common, but two or three can usually be found around the semi-formal area of the Park during August and September.

The Gossamer-Winged Butterflies (Lycaenidae)

Of the nine Lycaenidae recorded from insular Newfoundland, only four have been recorded within the Park. These are:

Brown Elfin (*Callophrys augustinus* West)
Bog Copper (*Lycaena epixanthe phaedrus* Hall)
Spring Azure (*Celastrina argiolus pseudargiolus* B. & Lec.)
Northern Blue (*Plebejus argyrogonomon aster* Edw.)

Of the four, only the Spring Azure is common and well distributed throughout the Park. It usually appears in early May and the occasional one can be seen, still on the wing, in early July. Its favourite host in the Park, possibly also in Newfoundland, is Wild Raisin (*Viburnum cassinoides* L.). A diligent search amongst the faded flowers and young berries of this plant during mid-July will usually be rewarded with a larva or two. These larvae blend very well with their surroundings and are very easily overlooked.

The Brown Elfin appears in early May, the Bog Copper and Northern Blue in mid-July. Little is known about these three butterflies in the Park. The Brown Elfin has been seen to fly at both the Jutta Arctic and the Milbert's Tortoise Shell, and the Northern Blue to fly at the Pink-edged Sulphur.

The Skippers (Hesperiidae)

Of the five skippers recorded from insular Newfoundland, only two have been found in the Park. These are:

Arctic Skipper (*Carterocephalus palaemon* Pall.)
European Skipper (*Thymelicus lineola* Ochsenheimer)

The European Skipper appeared in the Park in 1976 (3 August, first record for Newfoundland) and has since become well established in rough, grassy areas in the semi-formal section. It is on the wing from mid-July to mid-August. It visits a number of flower species including some of the non-native exotics in our flower beds.

Unlike the European Skipper, which can be seen by the dozens in suitable areas, the Arctic Skipper is decidedly uncommon. In the Park it is only found in, or close to, damp grassy areas, and does not seem to inhabit the drier grassy sites. They appear before the European Skipper, in late June or early July. Having a low, fluttering flight, they easily remain unnoticed unless one is particularly watching for them. The most I have seen during one day, checking all known sites, is six individuals. Males will establish and defend a territory, chasing away certain other creatures such as Inornate Ringlets and bumble bees.

The Future

Thinking ahead, I would like to think that we not only maintain the presence of those species already in the Park, but also may encourage other native butterflies to settle in the

area. Actually there are very few additional species we could expect since many of the butterflies on the Newfoundland list are decidedly rare and possibly restricted to very specific areas of the province. Perhaps the numbers of some of the less common, though widely distributed butterflies, could be somewhat increased by providing suitable host plants in a multitude of favourable sites. Certainly I shall be trying to boost our population of Atlantis Fritillaries and Pearl Crescents by providing additional violets and asters in sunny, damp areas. I have already mentioned our intention of creating blocks of deciduous forest which should certainly make our area more suitable for a number of species.

We will also continue our experiments to encourage butterflies to move along certain prearranged flight paths, so that our visiting public have a better chance of seeing them. If there is ever the available time and money I would hope to set up some form of marking program, to give us an idea of how many butterflies are moving through the area. Is the Red Admiral or Painted Lady we watched on the beds today, the same one we saw there yesterday?

There must be many other nectar sources of value in our area that are yet unknown to us. We will continue our efforts to locate and test any suitable native or exotic flower type.

Artificial wintering sites, suitable for use in the home garden, may be experimented upon, possibly in conjunction with our work on large flight cages.

Conclusion

Assuming that the perpetuation of our butterfly fauna is both necessary and desirable, we have to ask ourselves whether or not the applied science of Butterfly Production Management (Kulman, 1977) is of any real value. Our project is related to the preservation of all life on earth and, though I personally have a particular fondness for butterflies, they are managed and used in the Park as a means towards an end. They are living, natural things of great charm, beauty and fragility; excellent subjects to help kindle the flame of conservation ethic. Looking at the matter simply from the point of view of conserving native butterflies indefinitely, management may not be of lasting value. Indefinitely is forever. Politics, attitudes and economics change, enthusiastic humans pass on. Be this as it may, management based on whatever sound knowledge is available is, I feel, both practical and beneficial, certainly until such time as something better comes along.

Some forms of butterfly management may be self-defeating. The encouragement of an unnaturally high butterfly population in a restricted area may also encourage an increase of parasitic wasps and flies and other detrimental factors. Populations would then be inclined to level off to a more natural density, possibly dropping to numbers incapable of enthusing the visiting public.

We certainly intend to continue trying to manage our butterflies, particularly the showy backyard species. Since it is our job to strive for an area of complex diversity of habitats and native flora, it is possible that we will also succeed in maintaining a healthy and diversified butterfly fauna.

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Notes

Results of the Lepidopterists' Society's "Questionnaire on the Application of the Federal Endangered Species Act of 1973 to the Lepidoptera"*

In late 1978 and early 1979, the Lepidopterists' Society distributed a questionnaire to its 1400 members as directed by the Executive Council. The questionnaire's purpose was to assess members' feelings concerning the application of the Federal Endangered Species Act of 1973 to the Lepidoptera. Since members of the Executive Council were divided on the issue, the Council sought to determine the feelings of the membership-at-large by means of that questionnaire.

A total of 540 questionnaires was returned, representing approximately 38% of the membership and from throughout the world (but primarily from the United States, where the majority of members reside).

Unfortunately, some members returning their questionnaires suffered from the illusion that we were only seeking responses from those who believed, in principle, in the conservation of Lepidoptera (Question 1). At least they (13 individuals) returned their questionnaire for tabulation, and appended comments stating that they considered it to be "loaded" and poorly worded ("I still beat my wife, too." added one venerable member), or that "Conservation benefits only a selected, privileged few." One member wrote, "I answered your questionnaire but didn't bother to send it back. I checked 'No' on Question 1 and it was obvious that if I did that I could promptly drop dead as far as you (the Secretary and/or Society) were concerned. You wanted 'Yes' help and that was it!" That letter was tabulated as a "No" vote in the results below.

Admittedly, questionnaires of this sort run a great risk of being statistically invalid since people who bother to answer questionnaires constitute a special class. We can only hope that the opinions of this class are in direct proportion to the opinions of the 62% of the members who did *not* return their questionnaires. If not, the tabulation of results may be meaningless. However, as in an election, individuals who take the effort to voice an opinion are presumed to represent the entire group, and the leaders act accordingly. The Executive Council of the Lepidopterists' Society will rely on the results of this questionnaire for any further actions it may contemplate concerning the Society's role in the endangered species controversy.

Some 263 of the questionnaires (48.7%) were returned with additional comments, in several cases amounting to three typewritten, single-spaced pages. These were initially analyzed separately from those returned without comments, to detect whether there was any correlation between making comments and the way the questions were answered. The result was that the responses of the two groups (those who made comments and those who did not) were virtually identical. Consequently, the data from the two groups have been pooled to form one tabulation.

Of those who did provide additional comments, the greatest differences noted were that (1) more *favored* action by private conservation organizations, such as the Nature Conservancy (72.2% vs. 67.6%); (2) more *opposed* action by scientific and/or specialist societies (7.8% vs. 2.2%); and (3) for all four parts of Question no. 2 (choices of measures to achieve conservation of Lepidoptera), respondents *with* additional comments tended to be more decisive in their answers, since fewer of them chose the alternative of "No Opinion" or no response ("No Opinion" responses for all four questions ranged from 5.5% to 16.1% of the respondents *with* comments vs. 7.4% to 19.5% in the groups that offered no additional comments).

The Results

QUESTION 1: "Do you believe in principle in the conservation of Lepidoptera?" This question must be akin to those asking if one believes in motherhood or the sanctity of life, for a resounding 96.1% of the respondents said "Yes," while 2.4% (the 13 individuals mentioned earlier) said "No," and another 1.5% were either uncertain, had no opinion, or did not answer the question. Since Question no. 2 only sought opinions of those who *did* believe in the conservation of Lepidoptera, the 13 "No" questionnaires were not tabulated further (leaving a total of 527 for the following analysis).

QUESTION 2 consisted of four non-exclusive choices for the measures favored to achieve the conservation of Lepidoptera.

CHOICE 2 a: government legislation, such as the Endangered Species Act of 1973:

Favor:	55.6%	(293)
Oppose:	31.9%	(168)
No Opinion/No Response:	10.8%	(57)
Uncertain, or with Reservations:	1.7%	(9)
TOTAL:	100.0%	(527 responses)

CHOICE 2 b: action by private conservation organizations such as The Nature Conservancy:

Favor:	69.8%	(368)
Oppose:	11.6%	(61)
No Opinion/No Response:	17.8%	(94)
Uncertain, or with Reservations:	0.8%	(4)
TOTAL:	100.0%	(527 responses)

CHOICE 2 c: action by scientific and/or specialist societies, such as The Lepidopterists' Society and the Xerces Society, such as establishing formal codes or guidelines for collecting, the preservation and disposition of collections, etc.:

Favor:	87.7%	(462)
Oppose:	4.9%	(26)
No Opinion/No Response:	6.5%	(34)
Uncertain, or with Reservations:	0.9%	(5)
TOTAL:	100.0%	(527 responses)

CHOICE 2 d: action by individual lepidopterists through personal example and influence brought to bear on other members of the peer group:

Favor:	76.7%	(404)
Oppose:	7.0%	(37)
No Opinion/No Response:	16.3%	(86)
TOTAL:	100.0%	(527 responses)

From the above results it can be seen that *all* questions and choices listed on the questionnaire received a majority of *favorable* responses. The degree of preference, however, varied from a high of 87.7% favoring action by societies, down through 76.7% favoring personal example and influence, 69.8% favoring action by private conservation organizations, to 55.6% favoring government legislation.

A further analysis was made of the 461 questionnaires which had a definite "Favor" or "Oppose" response to Question 2 a, concerning government legislation. Elimination of the "No Opinion," no response, and ambivalent responses increased the differences, so that 63.6%, or nearly two-thirds, *favored* government legislation, while 36.4% *opposed* it. In the tabulation below, there are several very obvious correlations between how people responded to this part of the question and how they responded to the remaining three parts of the question (an asterisk [*] marks the responses which have notable differences). For brevity, "*b, c,* and *d*" are used to refer to the last three parts of Question 2 (see above for full wording).

Of the 293 who FAVORED government legislation:

*70.3%	(206)	also favored *b, c,* and *d*
6.8%	(20)	also favored *b* and *c*
3.4%	(10)	also favored *b* and *d*
* 5.5%	(16)	also favored *c* and *d*
2.4%	(7)	also favored *b* only
* 6.5%	(19)	also favored *c* only
* 0.7%	(2)	also favored *d* only
4.4%	(13)	did not favor *any* other alternative
100.0%	(293 responses)	TOTAL

Or, to look at it from another perspective:

*82.9%	(243)	favored *b* (private conservation organizations)
89.1%	(261)	favored *c* (society action)
79.9%	(234)	favored *d* (personal example)

Of the 168 (36.4%) who OPPOSED government legislation:

*41.7%	(70)	also favored *b, c,* and *d*
7.7%	(13)	also favored *b* and *c*
4.2%	(7)	also favored *b* and *d*
*26.8%	(45)	also favored *c* and *d*
1.8%	(3)	also favored *b* only
*10.7%	(18)	also favored *c* only
* 5.4%	(9)	also favored *d* only
0.6%	(1)	did not favor *any* other alternatives
1.2%	(2)	expressed qualified or mixed alternatives
100.0%	(168 responses)	TOTAL

Or, from another perspective (compare with above):

*55.4%	(93)	favored *b* (private conservation organizations)
86.9%	(146)	favored *c* (society action)
78.0%	(131)	favored *d* (personal example)

The highlight of the preceding set of figures is that people who favor government legislation for the protection of butterflies are also much more likely to favor any and all other alternatives proposed in the questionnaire, while those who oppose government legislation are much less likely to do so. In fact, for some reason unclear to the compiler, the cause of this discrepancy appears to be the fact that those who oppose government legislation are also much less likely to favor action by private conservation organizations (Choice 2 b).

As of this date (26 June 1979), I have not had time to complete an analysis of the comments provided on 263 questionnaires. It is evident, however, that the single most frequent comment pertains to "Habitat Protection," and its importance in maintaining butterfly populations.

A few samples of other comments offered:

"Ban trade except by permit system for true research only."

Breed endangered species both for supplying demand by collectors and scientists, and to reintroduce species into original or potential new habitats where protection is assured.

Establish "bag limits" or "taking limits," as is done for game and fish.

Designate precise geographical boundaries where a species is protected, and allow collecting outside this area (peripheral stragglers probably would not contribute much to the population anyway).

"[Federal legislation] can cover only the most obvious cases on a *national* level. Local action for taxa endangered in a particular state or region is also necessary. . . ."

Amend the Endangered Species Act to allow the "taking" of endangered species of Lepidoptera and other insects, in recognition of the fact that collecting of invertebrate animals does not have the same impact on the population as the collecting of vertebrates.

"Stop collecting!"

"I do not believe that collecting is a significant factor in reducing population levels."

"When any species is declared endangered or threatened. . .there should also be some kind of mandatory procurement funding made available for purchase of habitat areas. . .To simply place species on some sanctified list becomes an empty and meaningless gesture if not coupled with efforts to insure that the natural habitats so vital to their continued existence are not provided for."

Julian P. Donahue, Department of Entomology, Natural History Museum of Los Angeles County, 900 Exposition Boulevard, Los Angeles, California 90007, USA

**Editor's Note*: It is gratifying to know that the large majority of Lepidopterists' Society members answering this questionnaire support conservation. Some ideological differences remain, with different approaches preferred by various groups of members. It is clear, however, that our counterpart organization as a whole stands behind our efforts. With the Xerces Society program falling squarely in the area of greatest concern (protection of habitat), we can look forward to increasing support and cooperation from members of the Lepidopterists' Society.

Comments on the Lepidopterists' Society Conservation Questionnaire

Ever since I addressed a meeting of the Lepidopterists' Society in Corvallis, Oregon in 1967, on the subject of conservation, I have been anxious to see greater involvement on the society's part. Indeed, had the old, nominal Conservation Committee of the Lepidopterists' Society (which grew out of that meeting) ever become really active, the Xerces Society might never have been born. This is probably all for the good, since the groups fill separate, but complementary roles. Nonetheless, it is gratifying now to see this outpouring of opinion from the world's preeminent association for Lepidoptera study

and enjoyment. The Xerces Society welcomes this questionnaire and congratulates Julian Donahue on the excellent manner in which he carried out this mandate from the Executive Council of the Lepidopterists' Society.

Unfortunately, the wording of the questionnaire addressed only part of the topic of conservation, and tended to stress (at least in the minds of the beholders) the question of collecting restriction. This caused a blurring of results from those who favor habitat conservation but fear or resent interference with collectors' rights. Nevertheless, we can be quite pleased about the results on the whole. Julian Donahue's analysis furnishes some interesting facts about the responses received. The following comments attempt to outline or emphasize some other aspects of the results, to explain some of the enigmatic answers turned in, and to mine anything that pertains specifically to the Xerces Society and its goals.

To begin with, the document mailed to members of the Lepidopterists' Society contained two rather unfortunate flaws in its wording. Neither, we believe, was intentional, rather they were the kinds of omissions which can easily appear in any such sampling of diverse opinions. Even so, they were rather serious with respect to the results. First, the only mention of the Xerces Society was in regard to codes or guidelines for collecting. Our policy on the matter is clear, and we would have liked to be represented in connection with our primary involvements and goals: that is, habitat conservation. We shall be delighted to work with the Lepidopterists' Society in an ecumenical effort to inspire appropriate collecting guidelines. However, the Xerces image and substance were somewhat short-changed here. Second, Question 2(b) was worded in such a way as to be misunderstood by many respondents. This is clear from responses which explicity favored habitat conservation, yet answered this question "oppose," "no opinion," or with no reply at all. The question asked whether those who believed in conservation of Lepidoptera favored or opposed "action by private conservation organizations such as The Nature Conservancy." Sadly, too many people were unacquainted with TNC and did not know that the question meant HABITAT CONSERVATION ACTION. Somehow, they thought such private groups might be regulatory. Whether this means lepidopterists are paranoid or uninformed is immaterial: habitat conservation should have been mentioned explicitly in this question. Here are two responses which make my point:

> "To conserve Lepidoptera, a program of habitat preservation must be followed." This person OPPOSED question 2(b) about TNC! "I most *strongly* favour measures to protect the *habitat* of threatened and endangered species." This person had NO OPINION on 2(b).

Such responses clearly demonstrate The Nature Conservancy's failure to put its message and record across to biological groups. All lepidopterists in this country at least should be aware that TNC, with private money, has been responsible for the permanent protection of significant habitat for many rare butterflies and moths including *Problema bulenta* (Boisduval & LeConte), *Papilio aristodemus ponceanus* Schaus, *Apodemia mormo langei* Comstock, *Boloria selene* (Denis & Schiff.) relicts, *Hesperia dacotae* (Skinner) and *H. ottoe* Edwards, several megathymids and others. *H. dacotae* occurs on at least six Minnesota prairie preserves of TNC, and the Conservancy is funding research on the skipper's ecology and management along with Xerces and World Wildlife Fund. Over one million acres of habitat have been protected by The Nature Conservancy. We should broadcast that.

As Donahue points out in his analysis, there was a huge array of opinions and suggested approaches to the problem. The Lep. Soc. (as reflected by respondents) is quite closely split over whether or not government intervention is desirable in this part of our lives; hence, the group seems to be politically balanced. The question of overcollecting, whether or not it is possible, stimulates another opinion schism. Many say no; many say yes, and cite examples. No solid data are given by anyone. Respondents are not consistent. Some oppose government involvement altogether, but strongly support major habitat conservation programs; they seem unaware of the habitat provisions of the Endangered Species Act, in spite of the reference to same in the explanatory portion of the questionnaire. Curiously, many of those who disbelieve the potential for overcollecting, and who therefore oppose its regulation, nonetheless staunchly argue that all commercial activities involving Lepidoptera should be banned. The Endangered Species Act seems to have similar percentages of supporters and detractors. Many shades and hues of conservation philosophy emerge, along with an appalling amount of ignorance. If part of our job is conservation education, we get poor marks on educating our peers about the way conservation works.

One of the most fascinating aspects of the questionnaire was the fact that eight people replied "No" to the first question: Do you believe in principle in the conservation of Lepidoptera?" I have read their comments in an effort to understand why anyone would so respond -- at least, anyone with a stake in Lepidoptera.

Of the eight nay-sayers,

> One thought it would lead to a loss of collecting, hence study opportunities; yet he believes in national parks to protect representative ecological areas.
>
> One (not a native speaker of English) was cynical: "It is totally impossible. . .there are bad people who don't respect codes."
>
> One said he believed the only way was to protect biotopes, not individual species. (Of course, the latter requires the former).
>
> One highly respected lepidopterist wrote that he thought the questionnaire was loaded, hence he refused to respond seriously.
>
> Another thought only of collecting restrictions and red tape.
>
> And a sixth said "no" to question one, but related that he limits his collecting of rare species females to one per year, hence he actively practices his own brand of conservation.

None of these actually seem to oppose the setting aside of habitat for purposes of conservation of natural diversity. Their problems are semantic or their answers equivocal. Two persons actually seemed to be wholly against the idea of conservation:

> One of these responded, "Conservation only benefits a selected, privileged few" -- just who he had in mind he didn't reveal.
>
> The other opined that "if those types ('hysterical environmentalists' in his words, presumably Xerces-types!) were around to preserve the dinosaurs, we wouldn't even be here. We will get along very well without a blue hairstreak or whatever."

Of course, we believe that conservation benefits everyone, as we are all part of and dependent upon natural systems. It follows too that Lepidoptera conservation benefits all lepidopterists. We are privileged to be lepidopterists, it is true. . .but selected? Only by our own choice. As for the final reply, what can one say to a *non sequitur*? Perhaps only, "Lord have mercy on hysterical environmentalists and hairstreak-haters." This member with his cavalier response obviously hasn't been told that Nature bats last.

Finally, I was interested in what the respondents thought about the Xerces Society. Disappointingly, only 23 persons referred to Xerces in their comments. Here are some selections:

> "XS is designed for conservation, as Lep. Soc. is not."
> "Too poorly funded to do a significant task."
> "Societies can have no meaningful clout."
> "The Xerces Society makes me sick!"

I enjoyed the latter, but threw my hands up at this recommendation:

> "Set up a group to act as a lobby for more research into how to preserve Lepidoptera in areas threatened with development."

Someone -- the comment was not signed -- simply does not know about Xerces, and what Xerces is for. I suspect, actually, that this goes for a lot of someones. Others are unaware that private groups such as ours can have clout, when their members stand behind them; Xerces has shown this on many occasions, some quite recently. And someone else rightfully perceived our financial need, but he or she may be forgiven for not knowing that Xerces has a major fundraiser underway right now. Unfortunately, that note was also unsigned.

Without a doubt, the biggest lesson for us to emerge from this questionnire must be this: If we cannot keep lepidopterists better informed about the Xerces Society and Lepidoptera conservation in general, how can we expect to get our message across to the lay public? Lepidopterists, this sample shows, believe in conservation; they want habitats set aside or managed carefully; they applaud the private approach to conservation, and they have much to say on the subject. In short, they are with us. And yet, except for a handful of mutual members of both societies and one person with stomach troubles, they seem to know very little about us. Our course should be clear. (The Xerces Society would like to thank the Executive Council of the Lepidopterists' Society for conducting the survey, and Julian Donahue for analyzing it and giving us access to the returned questionnaires.)

Robert Michael Pyle, Swede Park, Loop Road, Box 123, Gray's River, Washington 98621, USA

Fifth International Symposium: Association for Tropical Biology

"The Biological Model of Diversification in the Tropics" was the title of the Association for Tropical Biology's Fifth International Symposium, held 8-13 February 1979 at the Hotel Macuto-Sheraton, La Guira, Venezuela. The meeting was partly sponsored by the World Wildlife Federation in view of its underlying conservation theme. Emphasis at the meeting was on the New World neotropics, specifically South America. Of primary concern to conservationists was the need, repeatedly emphasized throughout the meeting, to locate neotropical national parks and reserves so as to encompass "centers of endemism," areas of high species diversity and including primitive species restricted to such areas. These sites have been postulated to have been tropical forest "islands" (surrounded by grassland and savanna) during the Pleistocene period. These "islands", termed ice age forest refugia, expanded with the subsequent retreat of the polar ice caps, eventually joining to become continuous areas of tropical habitat virtually covering entire continents. Thus, the forest refugia were the genetic "reservoirs" from which today's floral and faunal tropical elements originated.

Additional details on the meeting appear in the Volume 6, number 3 issue of *Wings*, newsletter of the Xerces Society. The Xerces Society was represented at this meeting by President Larry Orsak, through the generosity of Society patron Marvyne Betsch. Proceedings of the symposium are tentatively scheduled to be published by the Association for Tropical Biology.

Larry J. Orsak, Department of Entomology, University of California, Berkeley, California 94720, USA

Recent IUCN Activity in Insect Conservation

The International Union for Conservation of Nature and Natural Resources (IUCN) takes a strong interest in conservation of invertebrates. In 1976, a Lepidoptera Specialist Group was established by Sir Peter Scott, Chairperson of IUCN's Survival Service Commission (SSC). SSC is the wildlife and natural diversity branch of IUCN, and its component groups help prepare an Action Program for world diversity conservation. This program figures heavily in the allocation of World Wildlife Fund money for conservation projects.

As Chairperson of the Lepidoptera Specialist Group, I attended meetings of the IUCN and SSC in Ashkhabad, Turkmenia, Soviet Union in 1978, and in Costa Rica and Cambridge, England this year. In Ashkhabad, a resolution was passed encouraging the Government of Papua New Guinea to establish an adequate habitat reserve for *Ornithoptera alexandrae* Rothschild (Queen Alexandra's Birdwing, the world's largest butterfly). This was sent as a letter from Sir Peter Scott. Such a reserve has since been set up.

In Costa Rica, another resolution was passed, encouraging the President of Mexico to take steps to ensure the perpetuation of the great Mexican wintering grounds of the Monarch Butterfly (*Danaus plexippus* L.). This too was conveyed in a letter from Sir Peter Scott.

Most recently, in Cambridge, the Lepidoptera Specialist Group received funds to investigate the potential for a Monarch conservation and biology symposium, and to examine the feasibility of a Monarch wintering grounds reserve. Funds for a number of additional Lepidoptera projects around the world were announced as available for fiscal 1980-1981. And a number of changes were made in the group, bringing the total number of members to 40. Paul A. Opler (Office of Endangered Species, United States Fish & Wildlife Service) was named Deputy Chairperson of the Lepidoptera Group. The Lepidoptera Group consists of representatives of various biogeographical regions, and workers actively engaged in Lepdioptera conservation research or projects.

Other invertebrate groups have already been established for Coral Reefs, Fresh-water Mollusks, Marine Mollusks, Odonata

and Cave Invertebrates. Additional groups are being considered for Other Aquatic Insects, Coleoptera, Orthoptera, Hymenoptera, and Arachnids. Updates of IUCN activities in this area will appear in future issues of *Atala*.

Robert Michael Pyle, Swede Park, Loop Road, Box 123, Gray's River, Washington 98621, USA

Studies on Endangered Prairie Skippers

A prairie skipper workshop and foray took place from 28-29 June 1980, in conjunction with an extensive "base line" flora and faunistic survey of the Loess Hill land formation in western Iowa. Field work commenced on 20 June, following a two-day workshop, during which both authorities and novices cooperated in designing an appropriate data-gathering strategy. The workshop was held at Lakeside Laboratory on Lake West Okoboji in northwestern Iowa, with appropriate trips to nearby Caylor Prairie for on-site studies. It is hoped that this "group" approach will initiate a productive series of both immediate and long-range studies and may be a model for concentrated work in other regions.

John C. Downey, Biology Department, University of Northern Iowa, Cedar Falls, Iowa 50613, USA

New National Wildlife Refuge for United States Endangered Butterfly

On 29 February 1980, the United States congressional subcommittees on Appropriation (Committees on the Interior) in both the Senate and House of Representatives approved a reappropriation of funds from the United States Land and Fresh Water Conservation Fund. This transfer enabled the United States Fish & Wildlife Service to complete purchase of two remnants (about 136 hectares) of the Antioch Dunes of Contra Costa County, California. This will become part of a preexisting local National Wildlife Refuge, administered by the Fish & Wildlife Service.

The remnants contain the sole populations of three Endangered species: Lange's Metalmark Butterfly (*Apodemia mormo langei* Comstock), Contra Costa Wallflower (*Erysimum capitatum angustatum* (Greene) G. Rossb.) and Antioch Dunes Evening Primrose (*Oenothera deltoides* var. *Howelli* Munz). Two plant species previously reviewed for possible federal protection also inhabit the area, as well as a number of additional insect species, some of which are endemic.

A Recovery Plan has been formulated by the Service. When put into effect, its purpose is to enhance populations of the Endangered species such that they can eventually be removed from the *List of United States Endangered and Threatened Wildlife*. The draft Recovery Plan for the Antioch Dunes Endangered species listed 1990 as the target date for their recovery; however, the plan is behind schedule in funding and habitat management and the Lange's Metalmark Butterfly has declined further in numbers since the plan was written (*Technical Bulletin*, Office of Endangered Species, Volume 5, number 9, September 1980, page 2).

Larry J. Orsak, Department of Entomology, University of California, Berkeley, California 94720, USA

Announcements & Notices

Status of the Journal

The beginning of 1981 has brought significant changes which we feel will allow *Atala* to rapidly return to its normal schedule. During the latter part of 1980, the Xerces Society President shed all editorial responsibilities for the journal, a first. And starting in 1981, no ATALA editor will be saddled with typesetting and layout responsibilities. We have begun what we hope will be a long-term agreement with Rudi Mattoni (Los Angeles, California) to handle the production end of the journal. These extremely important duties, so well handled by past-editor Robert Dirig, were simply too time-consuming for the *Atala* editor to handle in addition to the normal editorial responsibilities. With these changes in the division of labor, and the availability of suitable manuscripts, we expect to regain our intended schedule (Volume 9 in 1981) fairly quickly. Thus, we expect lag time between submission and publication of accepted manuscripts to be fairly short. At the same time, we intend to maintain established quality standards. Contributors should carefully read the "Suggestions for Contributors" on the inside back cover and prepare manuscripts accordingly. These should all be sent to *Robert M. Pyle, Atala Editor, Swede Park, Loop Road, Box 123, Gray's River, Washington 98621, USA*. Although past articles and notes have primarily concerned United States terrestrial arthropod conservation, we especially welcome manuscripts dealing with issues in other nations.

Larry Orsak, Editor

Book Review

The Naturalists' Directory and Almanac (International), **World Natural History Publications; x+310 pp; 1978. 43rd Edition. World Natural History Publications, 1330 Dillon Heights Avenue, Baltimore, Maryland 21228, USA. $12.95.**

A directory of about 3700 naturalists, both amateur and professional, this volume aims "to further international exchange of natural history specimens and information." The core of the directory is an alphabetical listing of naturalists with addresses and interest statements. These names are indexed in three ways: (1) geographically by country and city, (2) by special interest index search number, and (3) when applicable, by the particular taxa they are willing to identify for others.

The special interest search number system is designed to allow easy location of persons with a given interest, and the system seems to work. A search number is composed of four index numbers: 1. The subject of interest (taxonomic or other). 2. The geographical interest index (with categories from worldwide to parts of countries). 3. The general interest index (*i.e.* systematics, ecology, physiology, pest control, etc.). 4. The mode of interest index (*i.e.* collect, exchange, buy, identify, research, and combinations of these and others). Lists of these index numbers are given from which a search number can be easily compiled.

In addition to the directory, this volume also includes "The Naturalists' Almanac", which includes several other lists and short essays on natural history subjects. The geographically arranged lists of museums, zoological and botanical gardens, and natural history publications, are useful. Another list makes a valuable start on a compilation of field stations and preserved areas; one hopes this can be expanded in future editions. The final list presents the compiler's selection of the "100 most useful and best books on natural history", organized by subject. The book list will be most helpful to librarians as well as naturalists.

The natural history essays fall into two categories: the "Nature Fact File" and longer photo-essays. The "Nature Fact File" consists of eleven short essays on such subjects as butterfly life cycles, spiders as human food, and whale slaughter. The photo-essays treat green lacewings, aquatic insects in a stock tank, insect pheromones, bark beetles, and cicadas. All are written in a nontechnical style to appeal to the amateur naturalist and seem much more appropriate to a natural history magazine. The *Naturalists' Directory* would probably fulfill its purpose better by concentrating on the listings, which are of much greater use than the essays.

Many naturalists can benefit from the editor's comments on postal services (including proper address formats) and guidelines for requesting identification services. The volume includes a history of the *Naturalists' Directory* and a chronology of editions. Classified and display advertisements for natural history objects, supplies, and books are included also.

The *Naturalists' Directory* is a useful book. Naturalists can help increase the utility of future editions by submitting their new and revised listings for inclusion to: World Natural History Publications, Editorial Office, P. O. Box 505, Kinderhook, New York 12106, USA. As evidence of the fact that many naturalists have not included themselves, the Entomological Society of America had over 7000 members in 1978, compared to the 3700 listed in this volume.

Editor's Note: Perhaps the space used for essays in the current edition could better be allocated to conservation information. While the directory no doubt serves conservation as a medium for dialogue, its attention to issues of diversity preservation is minimal. One would like to see a cautionary word about the exchange of specimens, pertaining to rare and endangered species.

SCOTT E. MILLER, Santa Barbara Museum of Natural History, 2559 Puesta Del Sol Road, Santa Barbara, California 93105, USA

Abstracts of Recent Literature

Brief annotations are provided for recent or overlooked literature in the general field of arthropod conservation and ecology. Both scientific and popular sources are reviewed. Suggestions, references and reprints are requested so that this service can be maximally useful to readers. A photocopy of most papers abstracted in this column are available for personal use at cost (US $0.06 per page, plus postage) from the compiler, Larry J. Orsak (address on inside back cover). Please inquire as to reprint availability before sending money. Abstracts were written by the editors.

Politics and Issues

Bourgogne, J. 1975/1976. Measures to protect *Graellsia isabellae* (Attacidae). Alexanor 9:236. Mentions the need to protect this rare Saturniine moth and names five French communes where its unauthorized collecting has been banned.

Emets, V. M. 1977. Rare and disappearing species of diurnal butterflies in the Usmanskii forest and possible measures for their protection. Zool. Zh. (USSR) 56: 1889-1890. Twelve species of butterflies from the Usmansky Forest (Voronezh and Lipetsk Districts, USSR) have been placed under protection. Five of these are considered rare (*Lopinga achine, Coenonympha hero, Euphydryas maturna, Melaegeria daphnis* and *Maculinea arion*), three are disappearing (*Parnassius mnemosyne, Colias myrmidone* and *Apatura iris*), and four are apparently extinct from the forest (*Parnassius appollo, Erebia medusa, Benthis daphne* and *Zerynthia polyxena*). Protection methods considered are collecting prohibitions for adults and larvae, and establishment of reserves.

Jackson, B. 1978. Bye-bye Birdwing. Bull. Field Mus. Nat. Hist. February issue: 14. Review of world trade in butterfly specimens, particularly Birdwings.

Kloppers, J. J. 1976. Butterflies -- a word of warning. Fauna & Flora (Transvaal Nat. Cons. Div.) 34: 8-9. The author challenges South Africans to pay attention to small-scale conservation. Exotic conifer plantations along the escarpment of the Transvaal Drakensberg threaten the endemic blues, *Lepidochrysops swanepoeli, L. irvingi* and *L. jefferyi; Alaena margaritacea*, restricted to the Haenertsburg district, is also a species of concern.

Lamas-Mueller, G. 1978. Butterflies and nature conservation in Peru. Bull. Col. Suiza Peru 1978(4): 61-66. The overall situation with regard to the future of the 4000 species of butterflies in Peru is reviewed, in Spanish. Lamas-Mueller concludes that serious attention must be given to habitat protection soon; and that reserves must be very substantial in order to serve their purpose effectively.

Lipske, M. 1979. Habitat destruction leaves insects in danger. Defenders 54: 130-135. Described are the various types of habitat destruction/alteration bringing about the decline of insect species. Emphasis on United States insects.

Pyle, R. M. 1978. The importance of thinking small. Nature Conser. News 28(2): 25-26, 30. A rationale is provided for consideration of arthropod conservation by the Conservancy and other conservation organizations.

Pyle, R. M. 1979. How to conserve insects for fun and necessity. Terra (Nat. Hist. Mus. L. A. Co.) 17(4): 18-22. Examples of recent insect conservation work, especially along the Pacific coast. Compares the importance of insect trade to that of habitat destruction.

Ratcliffe, D. A., ed. 1978. A Nature Conservation Review: The selection of biological sites of national importance to nature conservation in Britain. Volume 1: Introduction (methodology, rationale, regional breakdown, diversity, etc.). Volume 2: Site accounts. Cambridge Univ. Press for the Nat. Conser. Council and the Nat. Environment Res. Council. The fullest, most up-to-date summary of biological conservation procedure in Britain.

Rittner, D. 1979. Karner blue butterfly nominated as threatened species. Skenectada 1: 66-67. Brief review of recent research on *Lycaeides melissa samuelis*, its protection under New York State endangered species law, and U. S. government decision to drop Albany Pine Bush as critical habitat resulting from 1978 amendments to Endangered Species Act.

Tariakson, T. 1979. Update on the Antioch Dunes. Yodeler (Sierra Club, San Francisco Bay Chapter) 41: 2. July/August. Reports on issuance of U. S. commemorative stamps picturing Antioch Endangered plants, and current federal efforts to acquire habitat.

Weber, S. 1978. Protection for rare butterflies. The Field (7 June) 1090-1091. The Earl of Cranbrook's amendment to the Conservation of Wild Creatures and Wild Plants Act of 1975 has been approved in the House of Lords. This would

protect vulnerable as well as endangered species of British wildlife. Characteristics of butterflies which render them vulnerable are briefly discussed.

Biogeography and Faunistics

Brown, K. S., Jr. 1975. Geographical patterns of evolution in Neotropical Lepidoptera. Systematics and derivation of known and new Heliconiini (Nymphalidae: Nymphalinae). J. Ent. (B) 44: 201-242. Analyzing 58 species of forest heliconiine butterflies for distributional patterns among some 300 races, the author discerned 38 core evolution areas. He suggests these represent Quaternary refugia.

Gibbs, G. W. 1976. The role of insects in natural terrestrial ecosystems. N. Z. Ent. 6: 113-121. Summarization of role of insects within natural forest and grassland ecosystems.

Glaser, J. D. 1977. (Untitled letter). Cicindela 9: 12. Reports decimation of the tiger beetle *Cicindela dorsalis* populations on the Maryland part of Assateague Island.

Howarth, F. G. 1979. Neogroaeolian habitats on new lava flows on Hawaii Island: an ecosystem supported by windborne debris. Pac. Insects 20: 133-144. Certain arthropods, especially a cricket (*Caconemobius fori*) and a wolf spider (*Lycosa* species) colonize new lava flows on Kilaeuea Volcano. These are specialized for a rigorous ecosystem dependent upon windblown organic debris following new eruptions. The Neogeoaeolion habitat is a newly discriminated ecosystem, but it has been available for circa 700,000 years. (Those described here are protected within Hawaii Volcanoes National Park -- *Editor*.)

Leffler, S. F. & D. L. Pearson. 1976. Tiger beetles of Washington. Cicindela 8: 21-60. *Cicindela columbica* is being adversely affected by dam construction along the Columbia and Snake rivers.

Opler, P. A. 1979. Insects of American chestnut: Possible importance and conservation concern. IN: Proc. Amer. Chestnut Symp. (eds. MacDonald, M. L.; Cech, F. C.; Luchok, J.; C. Smith). West Virginia Univ. Press. 83-85. American Chestnut (*Castanea dentata*)-feeding lepidopterans are surveyed. Most utilized other *Castanea*, but seven species may be monophagous. At least one appears extinct.

Rentz, D. C. F. 1978. New species and records of western Orthoptera. Pan-Pac. Ent. 54: 81-97. A new jerusalem cricket *Stenopelmatus navajo*, endemic to dunes of Coconino County, Arizona, is described. Author feels it merits "special consideration especially in light of the destruction of dune habitats by off-road vehicles."

(Schlauch, F. C.) 1978. The Oak Brush Plains: a doomed pine barrens heritage? Northeastern Field Natur. Soc.: Central Islip, Long Island, New York. 2 pp. Long Island Oak Brush Plains' flora/fauna distribution is described and vulnerability to proposed developments discussed. Lepidoptera here include: Buck Moth (*Hemileuca maia*), Edward's Hairstreak (*Satyrium edwardsi*), and Brown Elfin (*Callophrys augustus*).

Silbergleid, R. E. 1978. Inter-island transport of insects aboard ships in the Galapagos islands. Biol. Con. 13: 273-278. Insects attracted to shipboard lights are regularly transported among the islands of the Galapagos archipelago. As a result, biogeographic relationships of entomofauna are no longer subject to purely natural interpretation.

Populations, Ecology, Habitats

Brown, C. H. 1976. A colony of *Papilio aristodemus ponceanus* (Lepidoptera: Papilionidae) in the upper Florida keys. J. Ga. Ent. Soc. 11: 117-118. An apparently double-brooded population of this Threatened swallowtail located in the upper Florida keys in hardwood hammock habitat is described. Adult flight behavior briefly noted.

Dirig, R. 1978. A large diurnal breeding assemblage of American toads, *Bufo americanus americanus*, in the Catskill Mountains. Pitch Pine Natur. no. 4. December: 1-2. Marshland vegetation disruption by cattle grazing/trampling has negatively impacted populations of butterflies *Lycaena thoe* and *Lethe eurydice*.

Dumon, D. 1975/1976. Rearing of *Graellsia isabellae* (Attacidae). Alexanor 9: 205-207. Reports on the successful rearing of the subspecies *G. i. gallaegloriosa*, and the intention to introduce propagules into suitable habitats as a conservation measure.

Hardy, A. R. & F. G. Andrews. (1980). An inventory of selected Coleoptera from the Algodones dunes. Report to Bureau of Land Management. Contract CA-060-CT 8-68. 35 pp., 6 foldout maps. Five endemic Algodones dunes (Imperial County, California) beetle species studied, emphasis on distribution and biology of *Pseudocotalpa andrewsi*, a Threatened species candidate.

Hendrix, L. 1975. Relict bog. Pacific Discovery (Calif. Acad. Sci. San Francisco). [March/April] 28: 1-9. Moxee bog of eastern Washington, habitat for silver-bordered fritillary *Boloria selene*, illustrated and described.

Hilsenhiff, W. L. 1977. Use of arthropods to evaluate water quality of streams. Wisconsin Dept. Nat. Resources. Tech. Bull. 100. 1-16. Advantages of using arthropods as ecological indicators discussed. Concept tested in a survey of Wisconsin streams.

McCabe, T. L. 1977. Too late for some. Pine Plains 1(3-4): "(1)-(2)". Apparent disappearance of noctuid moth *Lithophane lepida* from its Albany Pine Bush type locality generates possible explanations for its demise.

Orsak, L. J. 1980. Buckwheat and the Bright Blue Copper. Garden. January/February issue: 24-27. Specializations limiting abundance of lycaenid butterfly *Lycaena heteronea clara* summarized. The necessity of similar studies on endangered butterflies is pointed out.

Perkins, E. M. & J. F. Emmel. 1977. A new subspecies of *Glaucopsyche lygdamus* from California. (Lepidoptera: Lycaenidae). Proc. Ent. Soc. Wash. 79: 468-471. *G. l. palosverdesensis* is described and distinguished from similar subspecies. Subspecies is localized to the Palos Verdes Peninsula of southern California, within the coastal fog-belt. Accelerated residential and commercial development threatens habitat.

Rentz, D. C. F. 1977. A new and apparently extinct katydid from Antioch sand dunes (Orthoptera: Tettigoniidae) Ent. News 88: 241-245. *Neduba extincta*, known from only one specimen collected at Antioch dunes, Contra Costa County, California, is described.

Schmidt, E. 1975. *Aeschna viridis* Eversmann in Schleswig-Holstein, Bundesrepublik Deutschland (Anisoptera: Aeschnidae). Odonatologica 4: 81-88. An extremely restricted dragonfly threatened by aquatic habitat disruption. Protective measures are suggested.

Slobodchikoff, C. N. & J. T. Doyen. 1977. Effects of *Ammophila arenaria* on sand dune arthropod communities. Ecology 58: 1171-1178. Dune stabilization by native plants increases arthropod diversity and numbers. Use of European Beach Grass *Ammophila arenaria*, disrupts the structure of sand dune arthropod communities which often is partly composed of rare/endemic species.

Spieth, H. T. 1974. The *virilis* group of *Drosophila* and beaver *Castor*. Amer. Nat. 114: 312-316. Author demonstrates that all but one species of this fruit fly group are semiobligatory commensuals of the beaver, and attributes their present rarity to decimation of the North American beaver populations within the last 200 years.

Management and Population Enhancement

Horn, D. J. & R. V. Dowell. 1974. A comparison of insect fauna in grazed and ungrazed grassland. Proc. N. Central Branch, Ent. Soc. Amer. 29: 103-105. Differences were found in above-ground insect fauna, using sweep sample techniques.

Jackson, B. S. 1979. Butterfly farming in Newfoundland. Can. Geog. 99(1): 16-23. Butterfly gardening at Oxen Pond Botanic Garden, with photos. The positive implications of butterfly production are evaluated.

Jackson, B. S. 1976. Butterflies of Oxen Pond Botanic Park -- their conservation and management. Oxen Pond Botanic Park, Memorial University of Newfoundland: Canada. 40 pp. Thoroughly treats butterflies of the park and vicinity, habitat management to enhance populations and conservation. Also sections on photography and rearing.

Neulieb, R. M. 1978. Butterfly country in your backyard. Country Scene. March issue: 62-65. Observing backyard butterflies and their enhancement through butterfly gardening. With notes on some common eastern United States species.

Newman, L. H. 1978. Bring back the butterflies. The Garden (J. Royal Hort. Soc.) 103: 282-284. The venerable author updates his advice on butterfly gardening.

Vietmeyer, N. D. 1979. Butterfly ranching is taking wing in Papua New Guinea. Smithsonian 10: 119-135. The author visited and now reports on the Insect Farming and Trading Agency, which revolutionized insect trade and conservation in Papua New Guinea. Habitat conservation efforts are also being pursued seriously by the Papua New Guinea government.

U. S. Office of Endangered Species -- Proposals, Rulings

Cook, R. S. 1979. Endangered and Threatened wildlife and plants: Review of the status of the Wilbur Springs shore bug. Fed. Regist. 44(144): 43709. Information on the hot springs endemic *Saldula usingeri* solicited by U. S. Fish and Wildlife Service to determine if listing as Threatened or Endangered is warranted.

Greenwalt, L. A. 1978. Endangered and Threatened wildlife and plants. Proposed endangered or threatened status or critical habitat for 10 butterflies or moths. Fed. Register 43(128): 28938-28945. Endangered status is proposed for the moth *Euproserpinus euterpe* and the butterflies *Glaucopsyche lygdamus palosverdesensis*, and *Hesperia pawnee montana*. Threatened status is proposed for the moth *Grapholitha edwardsiana* and the butterflies *Speyeria nokomis nigrocaerulea, S. callippe callippe, Hesperia dacotae, S. nokomis nokomis, Lycaenides melissa samuelis*, and *S. zerene hippolyta*. Critical habitat is proposed only for *G. edwardiana, H. dacotae, H. pawnee montana, S. callippe callippe, S. nokomis nokomis, S. n. nigrocaerulea*, and *L. melissa samuelis*.

Greenwalt, L. A. 1980. Endangered and Threatened wildlife and plants. Review of the status of the Uncompahgre fritillary butterfly. Fed. Regist. 45(26): 8029. Information on this new *Boloria* butterfly species is solicited by United States Fish and Wildlife Service, to determine whether it should be designated Threatened or Endangered.

Schreiner, K. M. 1978. Endangered and threatened wildlife and plants. Proposed endangered or threatened status and critical habitat for 10 beetles. Fed. Register 43(155): 35636-35643. Proposes Endangered status for *Agonum belleri*, and *Crossidius mojavensis mojavensis*; Threatened status for *Anthicus sacramento, Coelus globosus, C. gracilis, Desmocerus californius dimorphus, Elaphrus viridis, Phobetus robinsoni, Pseudocotalpa andrewsi*, and *P. giulianii*. All except *P. giulianii, A. belleri*, and *C. globosus* are Californian only. *Giulianii* is from Nevada, *belleri* occurs in Washington and Canada, *globosus* occurs in Mexico as well as California. Critical habitat maps are provided.

Wildlife Data Storage and Retrieval

Robbins, R. 1977. Scientific value of a butterfly collection. Lep. News no. 4 [July/August]: 3. Scientific value of a collection is measured by the amount of information it contains and the ease with which it can be retrieved. Specific types of information of value are: foodplant records, date and time of day for courting and copulating pairs. Importance of saving specimens of biological interest (aberrations, gynandromorphs, predator-damaged specimens) is also considered.

Shields, O. 1977. Endangered species; random alternatives. Lep. News no. 4 [July/August]: 2. Encourages amateur butterfly collectors to publish complete butterfly faunal lists from sites which might later be threatened by dams, etc., photographically recording eggs, larvae and pupae that one rears, and continued collecting of unexplored regions, adding specimens to museum collections to permit future taxonomic and bionomic work.

Endangered and Rare Organisms -- General

Lamas-Mueller, G. 1978. The Peruvian Amazon in the year 2000: rational utilization or irreparable destruction? Bull. Soc. Geog. Lima 97: 74-78. If the proper choice is not selected, the Peruvian Amazon will forfeit much of its diversity and most future use options for short-term profit in the next twenty years.

Newspaper and Children's Popular

Brownridge, R. A. 1972. Ranger Rick and his friends. Adventure No. 101. A tiny friend in trouble. Ranger Rick's Nature Mag. 11(5): 29-32. Karner Blue butterfly life history and population loss presented in a story for elementary school readers.

Laycock, G. 1976. Troubled butterflies. Boys' Life. December issue: 22. Reasons for protecting butterflies, why populations have disappeared, and early efforts by United States Office of Endangered Species to list Threatened/Endangered butterflies discussed. Focus on Apache silverspot (*Speyeria nokomis apacheana*) affected by Los Angeles water diversions.

Previously Overlooked

Doudoroff, M. 1935. Notes on two local butterflies. Pan-Pac. Ent. 11: 144. Specific former sites for now-extinct San Francisco *Plebejus icarioides pheres* given, with prediction that the species may be doomed to extinction.

Hovanitz, W. 1935. Notes on some California butterflies. Pan-Pac. Ent. 11: 190-192. Remarks on the Rocky Mountain butterfly *Oeneis chryxus* (Satyridae): "Maybe some day the government will take a hand in the protection of these beautiful things as it does with birds and flowers."

EDITORIAL STAFF OF *ATALA*

SUGGESTIONS FOR CONTRIBUTORS

Formal scientific articles and notes dealing with any aspect of the ecology and conservation of endangered or threatened terrestrial arthropods are solicited. Articles will generally be longer papers, notes not exceeding 1000 words. Reviews of books dealing with terrestrial arthropod conservation or endangered habitats are also invited. Appropriate philosophical papers will be welcomed for use in the "Commentary" section.

All manuscripts should be typewritten on white, 8½ x 11 inch, good quality bond paper, on one side only, double- or triple-spaced throughout, with margins of at least one inch on all sides. The original typescript and at least one (preferably two) xeroxed or carbon copies should be submitted; authors should also retain a copy of manuscripts and figures for later consultation with the editors.

Please include illustrations if appropriate. Figures should be consecutively numbered in Arabic numerals. Hand-drawn figures should be rendered in black ink on good quality white paper. They may be larger than final reproduced size. Black and white glossy photographs may also be submitted. These and artwork will be returned after publication if accompanied by return postage. Figure captions should be typed, double-spaced, on a separate sheet, and the number of the figure lightly pencilled on the back of each drawing or photograph. A sketch map should be included as a figure with all articles or notes dealing in a major way with a specific region or arthropod habitat.

Cover art changes with each issue, and contributions will be gratefully received. Cover illustrations should generally show insects or other arthropods in *living* poses, and prospective cover artists should consult with the Editor before submitting material.

Tables should be numbered consecutively in Arabic numerals and submitted in photo-ready condition on separate sheets. Please include full scientific name, *with authors*, for both plants and animals mentioned in any manuscript submitted for publication in *Atala*. The metric measurement system should be used, with English system equivalents in parentheses if desired. Full references to literature cited should appear in a separate section at the end of articles or commentary papers, but should be parenthetically incorporated within the text of notes. Please include an *informative abstract* of approximately 150 to 250 words with all articles. Avoid footnotes to text statements if possible; such information can usually be included within the text. Words to be set in *italics* should be underlined. Reprints of articles are available at cost. An author will receive a reprint order form after acceptance of a manuscript. The style of *Atala* generally follows that recommended in the *CBE Style Manual* (1972). Abbreviations of journal titles follow *Bibliographic Guide for Editors and Authors* (1974).

Prospective authors may request a copy of the detailed editorial policy of *Atala* from the Editor.

COVER

Sometimes misleadingly known as the seventeen-year locust, the periodical cicada must be one of the most remarkably specialized insects anywhere. The scientific name, *Magicicada septendecim* (L.), may allude to the seemingly magical qualities of an animal which appears as from nowhere, then vanishes for years and years. Adults of any one geographical brood mature only one year out of seventeen, or thirteen for a southern race. Meanwhile, throughout the extremely attenuated adolescence, the nymphs occupy a subterranean niche.

When adults emerge, they can be very numerous indeed, and seem anything but endangered. However, the kinds of soil conditions and woodlands required by the cicadas are highly liable to alteration for agriculture or other land-use changes. Chemical fertilizers and pesticides certainly can affect either the soil-bound nymphs or the arboreal adults. Logging, conifer planting or development spell doom for colonies whose adults, like Rip Van Winkle, arise to find everything changed.

Already at least one brood, Brood XI of Connecticut, has been declared probably extinct. Some of the others are diminishing. Efforts should begin soon to assess the status of all the broods, before a most wondrous organism should become truly rare. Wholly unique in nature, the loss of the periodical cicada would be scientifically tantamount to the extinction of the giant panda or the blue whale.

The drawing was rendered using pen and ink by Sarah Anne Hughes, a professional print-maker living in Washington State. Sarah has drawn earlier covers for *Atala* and founded the Xerces Society's annual Fourth of July Butterfly Count.

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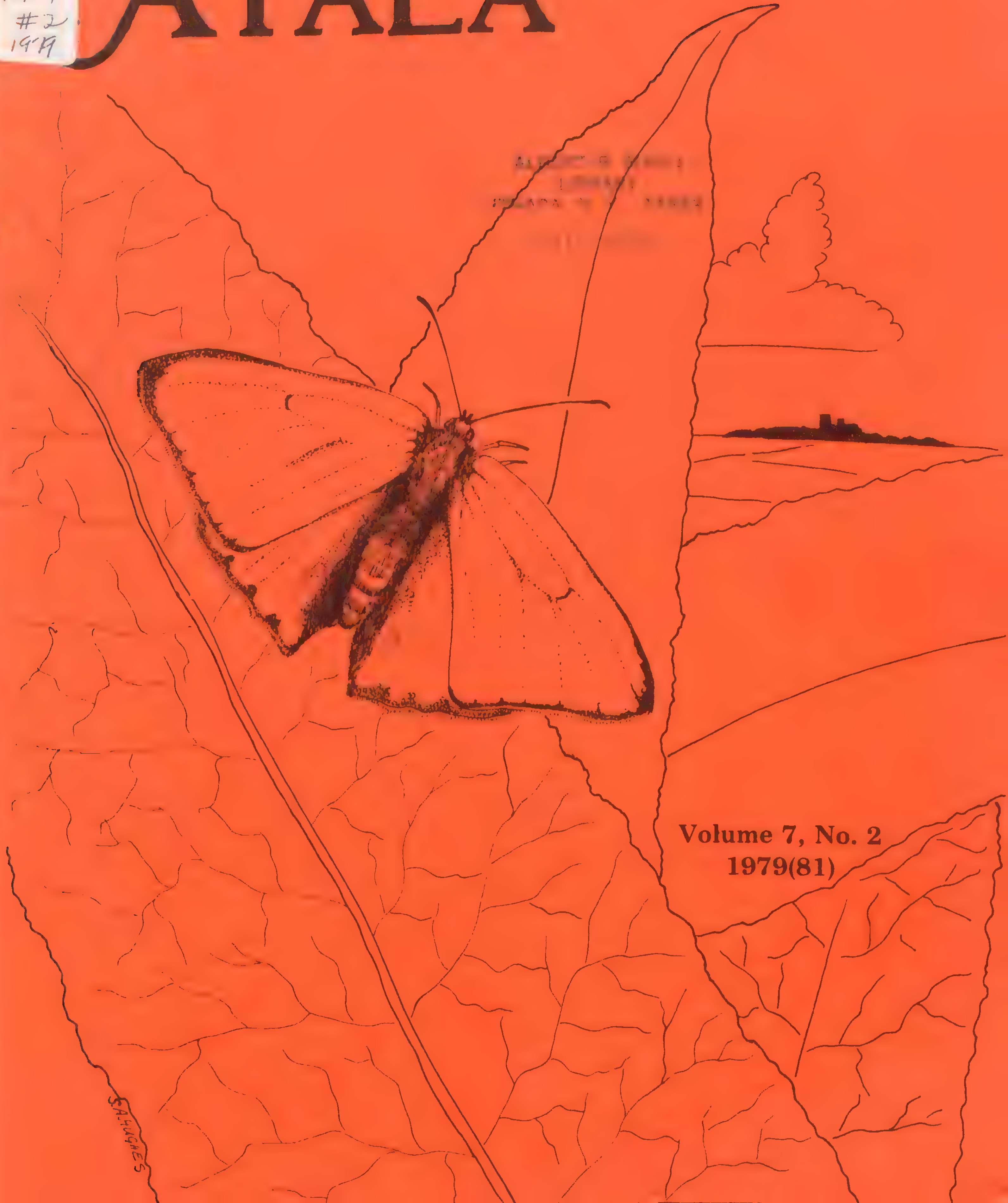

Volume 7, No. 2
1979(81)

THE XERCES SOCIETY

An international, non-profit organization dedicated to the conservation of terrestrial arthropods and their habitats. Named for the extinct Xerces Blue Butterfly, *Glaucopsyche xerces* (Boisduval). Founded on 9 December 1971.

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Membership in the Xerces Society is open to all interested persons and institutions upon submission of appropriate dues. Adult memberships and institutional subscriptions are US $8.00 and student memberships are US $4.00 for the 1980 calendar year. All members and institutional subscribers normally receive the journal *Atala* twice yearly; the less formal newsletter *Wings* three times yearly; *Self-Help Sheets* (informal, how-to-articles) and *Educational Leaflets* (short, informal, informational) irregularly, as they are issued; and Society meeting announcements, membership lists, and other communications. Xerces Society publication and administration costs are covered by dues and contributions, all of which are tax-deductible. A person or institution interested in receiving Xerces Society publications should submit name, address, and appropriate dues to the Treasurer, *Stephen Chang, 304 West 236th Street, Bronx, New York 10463, USA*.

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Published at Los Angeles, California, USA, in May 1981, by the Xerces Society in cooperation with The Lepidoptera Research Foundation.

ATALA

JOURNAL OF THE XERCES SOCIETY

Volume 7 | 1979(81) | Number 2

Introduction

Introduction to the British Issue

Robert Michael Pyle, Editor

In 1970, upon completing my early postgraduate studies in nature conservation, I had an urge to learn as much as possible about the conservation of butterflies and other insects. Quickly it became apparent that there was only one place where one could do so: the United Kingdom. Fortune smiled. John Heath, present Xerces Society Board member, invited me to come study at Monks Wood Experimental Station, the primary research base of Her Majesty's Nature Conservancy. Professor Kenneth Mellanby, then Director of Monks Wood, consented, as did Dr. Frank Perring, head of the Biological Records Centre (BRC),which was to be my base. The U. S. Fulbright-Hays Commission and its English counterpart body, intrigued and likely amused by my unorthadox subject, gambled support in the form of a fellowship. So for thirteen months in 1971-72 I immersed myself in British conservation, entomology, and ale. One direct result was the Xerces Society.

Under the tutelage of John Heath, Michael Morris, Jack Dempster, Norman Moore, Eric Duffey, Jeremy Thomas, Ernie Pollard, Gordon Mason, Lena Ward, Colin Welch, Michael Way, Max Hooper, Brian Davis, Terry Wells and others, I observed research and management and politics, listened, debated, queried and (I hope) learned. It was an enthralling opportunity for which I will be ever grateful.

And it came at the right time. That was Monks Wood's "golden age," when ecological investigators and reserve managers were all together under one sprawling roof or out in the field; when no fewer than a dozen civil servants were directing much or part of their professional time toward insect conservation problems, and when a venerable and many-layered private conservation movement also cared about invertebrates and the economy was such that it found ready support. It was a very exciting time to be there and to be in conservation.

Things changed later. The Nature Conservancy underwent a bureaucratic split into two entities, one for research, one for management, and the Monks Wood "team" was dispersed. Positions changed: Jack Dempster became senior officer at Monks Wood, John Heath became head of the Biological Records Centre and Mike Morris became head of the Invertebrate Ecology section of the new Institute of Terrestrial Ecology, based at Furzebrook Research Station, Dorset (where Jeremy Thomas went as well). The interest and the professionals were still there, and the private effort grew. But the centralized experience I was able to sieze would never be available again.

Ever since, I have wanted to share the results of the British experience through the pages of *Atala*. It is satisfying to be able to do so at last, with an entire issue devoted to the subject.

Why Great Britain—with only three score species of butterflies and as many millions of people, all squeezed onto a small island? The answer lies right there. Dense population, statistically, means many entomologists; yet dense population also means extinctions, and the fauna was small enough to begin with. The first entomologists' club, the Aurelians, met above a London pub in the early eighteenth century. We may never know whether they were concerned about conservation, for all their records and collections went up in the Great Fire of London. A century later, however, entomologists were lamenting the decline of the Large Copper of the Fens—an insect which soon became extinct. And from then on, the great swarm of insect scientists, collectors, students, and fanciers never lacked ardent conservationists among their number. A land with many enthusiasts, amateur and professional; and a small, pressured yet fascinating fauna, was the natural womb for the insect conservation movement. Furthermore, as is evidenced by its still astonishing loveliness, Britain is not an ordinary place when it comes to land ethic and concern for the countryside.

However, times are hard for conservation in the United Kingdom now, just as they are here. Mrs. Thatcher's concern over the loss of natural diversity is matched only by that of Mr. Reagan. Whitehall may have no minister to match the likes of Secretary Watt (could there be two such?) but, if anything, the British economy is even more stressful for the environment. The pound is up so the balance of payments is down. Employment is coming down, and so are the hedgerows. Prices are up; and the Large Blue is extinct.

So in presenting the British example, I do not intend to put it forth as being perfect. The problems facing British conservationists are enormous and excruciating. Species are being lost from reserves, leases are coming up for renewal with no funds to do so nor to manage the reserves properly in any case. Stress on the countryside is increasing, from housing, industry, agriculture and the Common Market, oil and gas exploration and recreation. Whether the United Kingdom can manage to sustain

its sung beauty and its natural diversity—perhaps the best known flora and fauna in the world—will depend largely on the kinds of endeavors and actions described in this issue. Facing similar problems and nearing the end of our ecological grace period, we should watch closely.

The following papers will introduce you to many of the facets of insect conservation in the United Kingdom. It is not all-inclusive, nor is it intended to be exclusive of any agency, group or individual's efforts. The field is so rich that only a sampling of the most important topics was possible to include. The first paper attempts to summarize the subject. This review was originally part of a worldwide comparative study written in 1976. I have updated it in part, but it fails to include certain recent developments and references. There may be some overlap with the other papers. However, it was felt that this review would furnish a useful springboard into this broad and fascinating topic: insect conservation in the United Kingdom.

I wish to thank all of the contributors to this issue, and all of those who aided my studies during my first and subsequent periods in England. I believe their work will give us all a great deal to contemplate, as well as inspiration and encouragement for the task in which we are all engaged.

Lepidoptera Conservation in Great Britain[1]

Robert Michael Pyle

Species Conservation Monitoring Unit of IUCN, 219c Huntingdon Road, Cambridge CB3 ODL, England[2]

The first human-caused extinction of a butterfly was documented in England in the mid-nineteenth century (Ford, 1967). The Large Copper (*Lycaena dispar dispar* (Haw.)) died out in 1847 or 1848. This may be reckoned as the catalytic event which sparked the development of the most advanced Lepidoptera conservation program in any country. To follow the entire evolution of British butterfly and moth conservation would require many pages. An outline, however, can be drawn that will show how nearly all of the relevant ecological issues have been raised during the British campaign to conserve rare insects. Useful background material and reviews of British Lepidoptera conservation were provided by Heath (1974) and Morris (1976).

The extinction of the English Large Copper came about as a direct result of the draining of the Fens of East Anglia for agriculture, a process which began in Roman times but became intense following a Dutch assist in the eighteenth century; market collectors may have provided a *coup de grace* (Duffey, 1971). Other extinctions, perhaps six in all, followed from other habitat alterations or climatic factors (Ford, 1967). By the early twentieth century nearly one-tenth of the British butterfly fauna known to the early collectors had disappeared. Recognition of this situation prompted publication of articles such as "The scarcity and disappearance of British Butterflies" (Frohawk, 1925) in the entomological journals. Ecologically rather naive, some of these notes ascribed butterfly diminution primarily to greedy collectors (Fryer, 1924) or to the protection of songbirds and gamebirds (Russell, 1925). Although these causes may have had a basis in some situations, they were not supported by data. Nonetheless, the British movement to conserve butterflies and other insects is rooted in these early expressions of concern.

Such a movement began to coalesce around the turn of the century. Ahead of his time, Charles Rothschild promoted nature conservation in on an ecological basis. "He realised the importance of protecting the habitat and special biotopes rather than the individual rare species threatened with extinction" (Rothschild, 1979). That is, he desired to maintain rare species, but recognized that collecting bans would not do it: habitat conservation was essential. Charles Rothschild founded the Society for Promotion of Nature Reserves in 1912, from which emanated in 1915 the first provisional schedule of British natural areas considered worthwhile candidates for nature reserves. Due to his entomological knowledge, the list of 284 sites included many habitats of critical importance for rare insects.

In 1925, the Insect Protection Committee of the Royal Entomological Society of London came into being. The Committee's first chairman was Charles's brother Walter, then Lord Rothschild. Eventually this group evolved into the Joint Committee for the Conservation of British Insects (see M. G. Morris, this issue). The Insect Protection Committee issued its first list of rare and endangered insects in 1946. Later, the scientific basis for habitat reserve establishment was laid down by *Command 7122,* the report of the Wildlife Conservation Special Committee, chaired by Sir Julian Huxley. This White Paper stimulated the creation in 1949 of a government body known as the Nature Conservancy (Morris, 1976).

After fifteen years, the Nature Conservancy evaluated its own efforts at "The Conservation of Invertebrates" in a symposium by that title (Duffey and Morris, Eds., 1965). This was the first staff symposium at Monks Wood Experimental Station, and probably the first insect conservation collaquiam anywhere. It

[1]Adapted largely unchanged from Pyle, R. M., 1976. *The Eco-geographic basis for Lepidoptera conservation.* Ph.D. thesis, Yale University. 369 pp.

[2]Permanent address: Swede Park, Loop Road Box 123, Gray's River, WA 98621, USA

Figure 1. Large Copper (*Lycaena dispar*) ventral, at Woodwalton Fen. Photo by Michael Skelton.

was attended by 32 representatives from most of the regional offices in England, Wales and Scotland and by five invited ecologists.

Four basic themes were explored in the symposium: (a) a review of the Conservancy's work in invertebrate conservation; (b) the relationship between invertebrate conservation and nature reserves; (c) the value of invertebrate surveys, and how they should be developed; and (d) organization of invertebrate collections within the Conservancy, and their use. Dr. E. Duffey revealed that of 550 ongoing research projects on the National Nature Reserves, only 47 related directly to invertebrates. There was general agreement that, although the original plan of the Ecological Society to preserve at least one example of each major vegetation type would in turn protect most insect species, there would be certain rare and valuable species which would not be taken care of without specific invertebrate research. Dr. M. G. Morris showed the value of insect surveys in surmounting these omissions and for reserve management in general.

Four major conclusions were drawn. First, a careful review of policy should be made concerning the selection of reserves for invertebrates and commitments for research into management of invertebrates on extant reserves. Second, management studies and fundamental research on invertebrates should be more closely coordinated and planned as part of a national conservation policy. Third, invertebrate surveys make an important contribution to the knowledge of wildlife on National Nature Reserves. They should be expanded with more funding, facilities and specialist personnel. And fourth, reference collections should be established at Nature Conservancy centers.

The two most pronounced needs emerging from this historical symposium, reiterated again and again, were for sophisticated biogeographical recording of invertebrates as a part of the Biological Records Centre (BRC) at Monks Wood; and for rigorous autecological studies on selected rare species of invertebrates, with respect to their potential management.

Both of these goals have been realized to a remarkable extent in the ten years since the symposium. One scientist, John Heath, contributed key work in both fields. His studies of *Eustroma reticulata* (Schiff.) in the Lake District (Heath, 1959) were the first real autecological investigations on British Lepidoptera species to be applied directly to conservation management. Later, he became Zoologist for the Biological Records Centre, with primary responsibility for mapping the distribution of British animals, including invertebrates. The first zoological atlas published was that for the butterflies (Heath, 1970), followed by the first set of moth maps (Heath and Skelton, 1973). Additional atlases have followed for other invertebrate groups. Applying advanced computer techniques to mapping the records provided by thousands of field recorders (Heath, 1971), the Insect Recording Scheme has produced an applied biogeographical tool of immense usefulness. By comparing updated maps from year to year, changes of range which may have implications for conservation can be visualized. Such long-term recording can be expected to illuminate the problems of British butterfly biogeography which Downes, Ford, and Beirne debated 20 years ago. Ford (1945) and Beirne (1947a) erected patterns of origin for the British butterfly fauna based on current distributions and Pleistocene ice movements. Downes (1948) showed that 13% of Britain's resident butterflies have undergone such marked changes in recent times that trying to interpret their origins by traditional zoogeographic reasoning based on current distribution is probably futile.

Such arguments have meaning for conservation. Natural climatological responses of butterflies and moths must be

Figure 2. John Heath and BRC staff in Biological Records Centre, Monks Wood. Photograph, courtesy of *Cambridge Evening News*, shows an earlier stage in biological recording automation.

separated from changes of range due to human impact, so that conservation managers can devote their time, money, energy and expertise to soluble problems. This is one way in which the autecological studies referred to above may be valuable. For example, concern over the recent scarcity of the Small Copper (*Lycaena phlaeas* (L.)) led Dr. Jack Dempster to investigate a population of that butterfly. His findings (Dempster, 1971a) suggest that *L. phlaeas* contracted its range to occupy optimally insolating habitats during the cool summers from 1962-68, and that it probably recolonized marginally suitable habitats in summer years when its numbers were higher. This type of pattern may explain the drastic range changes observed in *Ladoga camilla* (L.) (Pollard; 1979), *Polygonia c-album* (L.) and *Nymphalis polycholoros* (L.) in England. Other natural factors which have been known to influence the ranges and numbers of British Lepidoptera, such as succession, disease and flooding are documented by Beirne (1947).

Figure 3. Ernie Pollard of Monks Wood, with *Helix pomatia*, the Edible (or Roman) Snail. This large downland snail is becoming scarce and has therefore drawn the attention of biologists such as Dr. Pollard. Photo, *Cambridge Evening News*.

It should be noted that Morris (1967) attempted to deal with one of the problems he himself raised in the 1965 symposium, by reckoning the representation of butterflies on British statutory nature reserves. He urged that this process be updated from time to time, and be extended to moths (Morris, 1976).

Perhaps the greater contribution of the autecological studies on British butterflies and moths has been their direct application to conservation management. Heath's influential study cited above (1959) found that *E. reticulata* occurred on one host plant only, and only under conditions of high rainfall and dense cover. While the former cannot be managed, the latter can. (A species listed as in need of protection by the Insect Protection Committee, this geometrid moth requires certain habitat conditions to survive. Heath determined these requirements and provided cooperative land managers with conceptual tools for the moth's conservation.)

Perhaps the most publicized case of insect conservation in England involves the Large Copper. Although the British subspecies *L. dispar dispar* was exterminated in the mid-nineteenth century, continental varieties were introduced at various times to replace it. Initial attempts using the dissimilar subspecies *L. d. rutilus* Wern. from Germany were unsuccessful. The discovery of a fenland subspecies in The Netherlands occasioned a fresh attempt. This Dutch subspecies, *L. d. batava* (Obthr.), not only resembles *L. d. dispar* closely but also shares its habitat preferences. Populations were established in two remaining fenland enclaves, Wicken Fen and Woodwalton Fen (Ford, 1945). Both introductions eventually failed to maintain themselves naturally. However, a large stock has been maintained at Woodwalton Fen National Reserve by taking the diapausing larvae indoors during the winter and spring, when they would suffer high mortality from various predators; and releasing the adults on the marshes to mate and oviposit. In this manner, under the able practical management of Fenman Gordon Mason, a viable, if somewhat ephemerally available population of the Large Copper is maintained. Some consider this very unnatural, but others regard this butterfly as a spectacular natural resource now given a second chance and definitely worth the philosophical concessions and manipulation to keep. Having observed the Large Copper on Woodwalton Fen, I agree with the latter point of view; not only because of the spectacle provided by the Copper in its traditional haunts, but also because of the opportunity for research it presents.

That opportunity has been taken by Dr. Eric Duffey of the Monks Wood Experimental Station. His investigations aim toward establishing the microenvironmental needs of *L. dispar* and its host plant, Great Water Dock (*Rumex hydrolapathum* L.) (Duffey, 1968). In accomplishing this, he learned that the habitats at Woodwalton which favored growth of *Rumex* did not likewise favor ovipositional behavior by female coppers. Manipulation of sites and creation of shallow aquatic-transition zones in the form of shallow lenses cut into the peat seemed to solve the problem of presenting the female coppers with acceptable oviposition sites on dock plants which could maintain themselves with some management. The objective of a wild reproducing and self-supporting population of English Large Coppers seems near. As Duffey (1971) wrote, "In this example, successful management for an insect of high conservation interest required the creation of an anthropogenic ecocline between open water and a secondary fen sere."

A colleague of Dr. Duffey's, Dr. Jack Dempster, also of Monks Wood Experimental Station, has conducted elegant autecological research on Lepidoptera. His work on the Cinnabar Moth (*Tyria jacobaeae* L.) has shown what regulates the population of that organism, causing marked fluctuations and occasional extinctions of some colonies (Dempster, 1971b). Dempster has trained his field work toward a major conservation

problem, which the Cinnabar Moth is not. The British Swallowtail, *Papilio machaon britannicus* Seitz, is another fen endemic. It maintains a stronghold in the Norfolk Broads coastal fens, which the Large Copper never was known to occupy. A second holdout from the draining of the rest of Fenland was the colony at Wicken Fen. This famous locale lost its Swallowtail population during World War II when the *Phragmites* fens which favored the butterflies' host plant, *Peucedanum palustre* L. were neglected and succeeded to sallow carr (scrub). Subsequent introductions of Norfolk *P. machaon* to Wicken Fen have not succeeded in re-establishing the butterfly there. The biological foundations for these repeated failures was discussed by Dempster, *et al.* (1976). On-going research seeks to establish a program for introduction and re-establishment of the Wicken colony in a manner which would be viable in terms of both genetics and population biology (Ed. Note: see p. 71).

Working with Dempster, Jeremy Thomas conducted his doctoral research on an autecological conservation problem of similar intrigue and difficulty. The Black Hairstreak (*Strymonidia pruni* (L.)) was first discovered in England from Monks Wood in the last century. Restricted to Blackthorn (*Prunus spinosa* L.) stands in oak-ash Woodlands along a belt of low-lying clay soils from Oxford to Peterborough, the Black Hairstreak has become absent from a growing number of woods in recent years (Thomas, 1974). A species of very high interest among entomologists, *S. pruni* has commanded a great deal of attention and the mandate for its careful study has clearly been established. By compiling careful life-tables, including all mortality factors, for this and a related species, the Brown Hairstreak (*Thecla betulae* (L.)), and by studying their natural history in great depth, Thomas (1973) worked out the environmental requirements for a woodland in which these two theclines can survive. The necessary ecological conditions include a certain age-structure among the Blackthorn, as well as the presence of oaks of a certain size to serve as ethological triggers. The formula provided in Thomas' work has begun to be applied in local conservation schemes, as well as in this British type locality, Monks Wood.

Dr. Thomas later took on perhaps the greatest challenge in British insect conservation—the management ecology of the Large Blue (*Maculinea arion* (L.)). That story is told elsewhere in this issue by Jeremy Thomas.

In addition to Dr. Thomas' federally contracted research on the ecology of *Maculinea arion*, the Gloucester Trust for Nature Conservation and the World Wildlife Fund supported investigations aimed at the insect's conservation. Reporting on this work, Muggleton and Benham (1975) put forth another theory for the progressive disappearance of *M. arion* in England. They showed that it had once been quite continuously widespread over much of Southern England, but that its habitat became highly compartmentalized during the last two centuries as old grasslands were ploughed and otherwise changed. Muggleton and Benham argued that fragmentation may have brought about local extinctions because of genetic isolation, whereby populations would concentrate deleterious homozygous recessives. They invoked the Sewall Wright Effect (Wright, 1948) as a possible random mechanism for such a genetic course of events. In my view, events do not support this conjecture.

Whatever the ultimate cause of the Large Blue's British retreat may have been, it probably had multiple factors which acted synergistically upon one another. The situation is a complicated one, and it demonstrates that habitat conservation alone is not always enough—for *M. arion* vanished from fully protected habitats. This is the only case of which I am aware in which butterfly wardens have been employed to guard against the killing of specimens. At the time (1972) they had no statutory authority, but since then the Large Blue has been legally protected from collectors in Britain. It is the only one of the country's national rarities for which the Joint Committee for the Conservation of British Insects considered a total collecting ban necessary at that time. To scientists such as Graham Howarth of the British Museum of Natural History, however, the eco-genetic odds against British *arion* seemed all but inexorable (Howarth, 1973). Since the extinction of *M. arion* in Britain, there may be popular sentiment for re-introducing the species from continental stock, as was done with *Lycaena dispar* at Woodwalton Fen. That approach is not acceptable as long as the indigenous genotype may conceivably survive.

Complementing the species-specific work is systems ecology. Of course, nearly all synecological research can be potentially valuable in habitat management. Three examples may be cited in which careful, integrated studies of systems have had specific implications for Lepidoptera in Great Britain. The first of these is Wicken Fen, where specialists including Charles Darwin have pooled the results of their studies in hundreds of publications over a period of two centuries or more. These studies have laid the base for conservation management of a wide variety of rare insects. The second example is Woodwalton Fen, discussed above. Eric Duffey's approach, with the Large Copper as one major aspect, has been "multidisciplinary," as he put it (1971). Since many other uncommon organisms occur at the fen, management directed toward the Large Copper is only part of the picture. Community management, based on synecological research as well as autecological studies of certain key organisms, is really what takes place at Woodwalton Fen National Nature Reserve.

The same is true for Monks Wood National Nature Reserve, which hosts many notable animals and plants including all five species of British hairstreak butterflies. A national center for woodland ecology research, grassland conservation studies, biological recording, and related work is situated at Monks Wood Experimental Station of the Institute of Terrestrial Ecology. With the publication of *Monks Wood: A Nature Reserve Record* (Steele and Welch, 1973), this reserve became a third available paradigm of conservation-oriented synecology. In addition to basic research on rare species such as the Black Hairstreak (*Strymonidia pruni*) and the development of butterfly census techniques, both referred to elsewhere in this paper, Monks Wood has been the scene of much of the best British research on the maintenance of diversity in a limited reserve setting.

A great many amateur studies and projects in Lepidoptera conservation take place in the United Kingdom. *Notes and Views of the Purple Emperor* (Heslop, Hyde and Stockley, 1964) contains no rigorous experimental data, but it presents masses of basically solid natural history material on this scarce and magnificent nymphaline. The management of *Apatura iris* (L.) and its host plant, sallow, in the proper environments, has much to learn from this encyclopaedic study. The authors themselves undertook a management procedure in concert with the Nature Conservancy and the Forestry Commission in a Wiltshire reserve, which they reported to have borne positive results. Heslop (1967) gave additional details about this reserve.

Numerous lepidopterists, both amateur and professional,

have contributed investigations and surveys of rare species and their habitats to the general fund of knowledge about British butterfly conservation. Examples are J. F. D. Frazer's studies of chalk grassland blues and their conservation (1965); R. M. Pyle's survey of the Heath Fritillary (*Melitaea athalia* Rott.) in its few remaining West Country habitats (1972); L. Farrell's status report on the declining Chequered Skipper (*Carterocephalus palaemon* (Pall.)) (1973); and Dr. J. R. G. Turner's observations on "The Last Marbled Whites in Yorkshire" (*Melanargia galathea* (L.)) (1973).

The efforts of organizations to protect and manage habitats for rare and endangered butterflies and moths in the British Isles should receive extensive consideration. Like the activities of the Nature Conservancy Council and the Institute of Terrestrial Ecology, however, these can only be outlined. In a country with interest groups for every conceivable purpose and with a great many naturalists in general and entomologists in particular, it is not surprising that insect conservation responsibilities have been apportioned among several bodies.

Chief among these (and a coalition of them all) is the Joint Committee for the Conservation of British Insects (see M. G. Morris, this issue). This umbrella group evolved out of the aforementioned Insect Protection Committee of the Royal Entomological Society of London, when it was realized that it would be beneficial to have representation from all the entomological societies as well as the Society for the Promotion of Nature Reserves (now the Royal Society for Nature Conservation) and government resource and research agencies (anon., 1969). I attended most of the meetings of the Joint Committee over a two-year period, as an observer. During this time, discussions were held on the development of a list of national rarities, which resulted in the publication of the first Lists of Rare and Endangered Species (Joint Committee, 1972; 1974). These included several species of Macrolepidoptera and other orders which the Committee judged should be collected with restraint, and given consideration for habitat conservation. Also during this period an expedition was mounted to Borth Bog, Wales, to investigate the possiblility of introducing individuals of the Rosy Marsh Moth (*Coenophila subrosea* Steph.) to Woodwalton Fen, where it formerly occurred and where its host plant still exists. Since Borth Bog is the last remaining locale for *C. subrosea*, it was felt that the introduction would be justified as an insurance measure against catastophe at Borth Bog. This expedition, in which I took part, failed to produce enough larvae for an earnest re-introduction experiment to be conducted. In any case, a serious question was raised of whether the Welsh conservation authorities would sanction the removal of part of the population of the Rosy Marsh Moth to England to enhance the already noteworthy Woodwalton Fen. This would appear to be a case of nationalistic feelings and jurisdictional jealousy impinging upon biological conservation.

A similar instance of internecine rivalry apparently cost conservationists one of the few remaining habitats of the Heath Fritillary (*M. athalia*) in Devon. Because of a breakdown in communications between regional and national conservation bodies, neither showed up at a public auction at which the land was sold by British Rail. A farmer, who owns the land adjacent, bought the disused railway cutting cum fritillary habitat, for possible gravel salvage (which would ruin the site), for nine Pounds Sterling!

Such is the exception, however. In the next county, another rich Heath Fritillary habitat was managed by the late Enid Campbell, volunteer warden and accomplished amateur ecologist, for the Cornish Naturalists' Trust. In this case, management took place in cooperation with the Duchy of Cornwall, the Nature Conservancy, and other authorities. Such cooperative ventures often receive coordination and technical guidance from the Joint Committee for the Conservation of British Insects. Occasionally, the Committee has sponsored field research in order to aid their understanding of particular management needs and techniques which might be useful in meeting those needs.

In addition to the important issues of habitat and endangered species, the Joint Committee has addressed the matter of collecting. Out of careful, measured consideration for many points of view, including consultation with all of the entomological societies, grew the moderate collecting policy espoused by the Joint Committee (see M. G. Morris, this issue). Its chief provisions are common-sensical. Basically, it says that rarities and depleted populations should be sampled with moderation; and that collectors should not damage or abuse the habitats which they use. The collecting code demands few sacrifices from entomologists, and their societies were quick to ratify it. As noted elsewhere, collecting has been banned altogether only for the Large Blue (and for the Large Copper, in Woodwalton Fen). The code seems to be a very workable one.

Collecting for commercial trade is a separate issue, one which is rather volatile in England (Owen, 1974; Morris, 1976). Recently, the Joint Committee has proferred a code of responsibility for dealers. It prescribes professional standards and prohibits trafficking in insects considered endangered in their countries of origin. All of the major dealers have agreed to adhere to the code. The presence of Robert Goodden, head of Worldwide Butterflies, Ltd., on the committee no doubt aided the process.

Robert Goodden was also instrumental in the development of the British Butterfly Conservation Society (BBCS). Founded in 1968 by Julian Gibbs and Thomas Frankland, BBCS was probably the first citizen's group in the world devoted to its particular cause. Sir Peter Scott is the Honorary President, Mr. John Tatham the current Chairman. BBCS activities consist of an aggressive habitat survey, habitat conservation action, public education, and breeding. A special panel insures that rear-release operations proceed on a sound biogeographical and genetic basis, rather than capriciously and arbitrarily. The habitat conservation action engaged in by the BBCS shows much promise for actual contribution. The latter, carried out by the Conservation Committee, has resulted in several demonstrable successes lately. In Warwickshire, the BBCS made a formal objection to the Department of the Environment that refuse tipping not be permitted in a disused railway cutting which is a outstanding butterfly habitat. The objection was upheld (Tatham, 1975). In Leicestershire the Society blocked a glue factory which would have destroyed habitat for the Small and Large Skippers (*Thymelicus silvestris* Poda., *Ochlodes venatus* Br. & Grey); and in Northamptonshire, reached a compromise with a development corporation to preserve a habitat harboring one-quarter of the remaining species of British butterflies as an Amenity area, while allowing the housing development to proceed beyond the habitat (John Tatham, *in litt.*, January 1976). When the Society learned that a small Devon field rich in fritillaries and other butterflies was about to be drained by the farmer who owned it, they entered negotiations with the farmer to lease the habitat as a reserve. (See also J. Tatum, this issue.)

The BBCS and the Joint Committee act as national fronts, though they often are able to act on a local basis due to the small size of the country. However, a great deal of the local-level Lepidoptera conservation originates with the organizations known as the County Naturalists' Trusts. These are active, under the administration of the Royal Society for Nature Conservation, in most counties in England. Three papers may be cited as detailing the actions of county trusts respectively in Somerset, Gloucestershire and Devon on behalf of insect conservation (Burton, 1971; Muggleton, 1971; Smith, 1968). Burton points out that the Wood White (*Leptidea sinapis* (L.)), considered rare but not in immediate danger, can be thought of as such rather than endangered partly because of its presence in numbers in a County Trust reserve near Frome. Muggleton notes the recent annexation of a tract of chalk grassland to an extant and adjacent woodland, one of the Trust's 27 reserves in Gloucestershire. This habitat will be managed especially for its rich butterfly association, and particularly for the chalk-land butterflies such as the Chalk-hill Blue (*Lysandra coridon* Poda) and the Marbled White (*Melanargia galathea* (L.)).

The Isle of Wight Natural History and Archaeological Society long ago adopted the island's endemic (for Britain) butterfly, the Glanville Fritillary (*Melitaea cinxia* (L.)) as its emblem. More recently, the Society has taken steps to protect the exposed seaside habitats of the butterfly, which have diminished in recent years. The conservation work was actively aided by the late A. Leslie Hutchinson (1969), and is to be carried on by a memorial fund in his name, as instituted by Professor G. Evelyn Hutchinson of Yale University and Mrs. Hannah Hutchinson. Cliffside erosion threatens stands of the *Plantago lanceolata* (L.) upon which the Glanville checkerspot feeds.

Naturally, the entomological societies themselves are concerned about habitat conservation. While they leave acquisition and management to the Trusts and other bodies formed for those purposes, the insect clubs have been most helpful in providing information on sites which should be protected. Alan Stubbs (1967) details the hazards threatening a number of the most productive field meeting localities of the South London Entomological and Natural History Society in the county of Surrey, near London. Afforestation, motorways, housing estates and intensive recreation appear among these perils facing the surprisingly rich habitats so near the metropolitan region. Stubbs goes on to discuss the protection afforded or considered for several of these field meeting localities by the Surrey Naturalists' Trust. For example, on Thursley Common, part of the heath is managed as a reserve by agreement with the owner, and a warden (who is an entomologist) has been retained to prevent incursions. A plea is lodged for entomologists to aid the Trust with records of rare insect distribution.

Figure 4. Monks Wood Experimental Station, Huntingdon, home of a great deal of rare invertebrate conservation research. Shown with former director, Professor Kenneth Mellanby, presently Chairman of Joint Committee for the Conservation of British Insects. Photo, *Cambridge Evening News*.

Figure 5. Jeremy Thomas conducting research on the Black Hairstreak (*Strymonidia pruni*) in Monks Wood National Nature Reserve. Photo, *Cambridge Evening News*.

This sort of divulgence of collecting data for use by land conservation officials constitutes one of the most constructive approaches to habitat reservation. Reticence to do so prevented the Royal Entomological Society of London from replying to query from the Huxley Committee requesting recommendations for reserve priorities (Frazer, 1965). Jealousy toward data has continued to be a bane to conservation cooperation, and, as Morris (1976) points out, these unsharing individuals often complain when a habitat they would not previously divulge to authorities is about to be damaged.

In fact, if anything seemed to be less than right during the writer's period of study (1971-72) among British insect conservationists, it was a lack of communication and coordination among the various bodies making up the movement. It was surprising to find that two groups were seemingly unaware of one another's actions. The kinds of mistakes this lack of awareness can lead to have been mentioned above. Duplication of effort also results from these communicative difficulties.

It now seems, however, that this trend is being reversed. Increasingly, collectors furnish information about favorite (and possibly threatened) locales. The BRC, BBCS and Joint Committee are definitely cooperating more closely, pooling resources and energy and awareness of one another's programs and objectives. The actual reservation of habitat for rare butterflies and moths in Great Britain can only benefit from such consonance of purpose. Various other ecological and political issues, will, of course, continue to be debated.

One of the most trenchant of these issues is the role of insecticides in the alleged decline of British butterflies. It is often stated that spraying has constituted the major factor in one or another local extinction or diminution of a population. Some of the only experimental investigation of this assumption has taken place in England, again at Monks Wood Experimental Station. Dr. Frank Moriarty (1968) subjected larvae of *Aglais urticae* (L.), the Small Tortoiseshell, to varying concentrations of DDT and Dieldrin, two of the most persistant organochlorine insecticides. He found that concentrations rather larger than might be encountered in nature were necessary to kill larvae outright. However, marked sublethal effects were observed including reduced fecundity and fertility of surviving adults from exposed larvae. Moriarty (1969) stated from the evidence that these sublethal effects, if they were to occur in the field, could "devastate" populations. In order to check the reality of such risk, Moriarty experimentally determined the amount of pesticide necessary to induce visible sublethal effects in adults; and then assayed wild individuals from Huntingdonshire, an agricultural district, to check whether such quantities were present in their tissues. A comparison of the two figures yielded a safety factor of more than one-hundred fold. While admitting conceivable criticisms of the results, Moriarty concluded that "the available evidence, though scanty, does not suggest that insecticides have caused the alleged decline in the numbers of butterflies."

That allegation itself is a subject of controversy in England. Difficulty in quantifying wild populations has hampered reliable monitoring the actual numbers of butterflies in the countryside. Three publications by Nature Conservancy scientists approached this problem. Frazer (1973) reviewed available means of estimating butterfly numbers, relating their appropriateness for conservation. Repeated transect counts, one of the methods suggested by Frazer, were conducted by his Monks Wood colleagues along the rides of Monks Wood. Elias and others (1974) described the results of the counts, their difficulties and potential, and their implications for habitat management. Pollard (1979b) evaluates the extension of the idea to other parts of Britain. The Monks Wood transects added much about the size of populations and the composition and areal arrangement of the fauna of the National Nature Reserve to that already known from a century of observation and collecting.

One of the reasons for the butterfly diversity and abundance of Monks Wood (Thomas and Heath, 1973) is the fact that, although altered many times and clear-felled at least once, it has remained an oak-ash dominated hardwood forest since Roman times and before (Hooper, 1971). In sharp contrast, many British woodlands which have undergone afforestation with conifers have lost much of their variety. The trend toward coniferization has produced a vehement reaction among nature conservationists. J. Little (*in litt.* 17 December 1975) wrote that in the early 1950s *Catocala fraxini* L., the Blue Underwing, established itself in the Ham Street area of Kent, where it was to be found in aspen copses. By 1973, evergreen plantations nearly replaced the aspens and *C. fraxini* was not to be found.

One such sacrifice to forestry most frequently complained of by entomologists is that of sallow bushes (*Salix caprea* L.) upon which the Purple Emperior (*Apatura iris*) feeds. Little (*in litt.* 17 December 1975) detailed a typical situation whereby exotic pines have replaced the hardwoods, including sallows, in a particular spot in northwest Sussex.

Michael Skelton showed me a habitat in Huntingdonshire known as Brampton Wood where he had collected a notably high number of species of moths and butterflies. Progressive coniferization and removal of old oaks by the Forestry Commission augured poorly for the lepidopteran resource here, and it was already showing losses.

Many more examples could be cited. As Little admitted, at least one species, the Pine Sphinx (*Hyloicus pinastri* (L.)), has expanded its distribution due to the artificial planting of its host plant in monocultures. On balance, however, the result of coniferization with Scots and Corsican Pine, Sitka Spruce and Douglas-fir has not benefited British butterflies and moths. The Forestry Commission has been defensive about this. In an excellent interpretive booklet on "Butterflies in Woodlands" published by that agency, T. C. Robinson (1970) relates "Some thoughts on the future of our butterflies in the changing forests of Britain." ". . . the impression I should like to give," wrote Robinson, "is that the situation is not so serious as it may seem." He concedes that woodland butterflies have become more local since the heavy forest demands of the world wars, but believes most of them are still well established. Robinson believes many butterflies will adapt to at least the more open conifer stands: ". . . it is encouraging to see (the Speckled Wood) flitting along the rides among spruce and Douglas-fir in Wales, including some newly afforested areas." Robinson places remarkable faith in butterflies to adapt thus: "Superficially there seems no reason why the handsome Purple Emperor, usually associated with lofty oaks, could not develop less conservative habits as the sallow will spring up in many types of countryside where damp conditions prevail." Lepidopterists such as Heslop and others (1964) have pondered over the ethological necessity for the Master Oak on the part of the Purple Emperor for many years; but it does exist, and that fact cannot be altered by such wishful thinking.

Robinson does go on, however, to assess the impact of coniferization of hardwood forests and afforestation of open land for uncommon species. He concludes that the felling of hardwoods eliminates broadleaf feeders such as most of the hairstreaks, and recommends the retention of amenity blocks of mixed deciduous trees. Likewise, he concedes the dangers that planting moors with spruces presents to the Large Heath (*Coenonympha tullia* Mull.) and the Scotch Argus (*Erebia aethiops* Esp.); and the threat of afforestation of chalk grassland to the Chalk-hill Blue (*Lysandra coridon* Poda.) and the Adonis Blue (*L. bellargus* Rott.).

Along with the general trend toward more efficient agricultural use of the land and the attendent elimination of rough ground, forestry plantings seem to represent a major vector of downward change in British butterfly populations. The trend toward replacement of English mixed hardwoods with exotic conifers for marginal economic return may be changing. Under great pressure from the amenity- and nature-oriented public, and demonstrating revolution of ideas within the agency, the Forestry Commission recently released a management plan for the famous and extensive New Forest. The plan calls for a virtual halt to evergreen planting in this former Royal game reserve.

Possibly the most evergreen debate in British entomological circles is that of over-collecting and its potential harm to populations of butterflies and moths. This argument prevails everywhere that people collect insects. In the United Kingdom, however, collecting seems to be a more volatile issue than in

most other places. This may be because there are more collectors here, per capita; and because many collectors have turned to non-consumptive activities such as photographing insects, there being less to be learned from specimen collecting in Britain than in countries where the pursuit is younger and the fauna larger (and hence, the challenge greater). Another reason for the exacerbation of the collecting controversy here may be that certain rare demes appear to be literally vulnerable to over-collecting, a fact which is very difficult to establish in most places. Scientists such as Jeremy Thomas agree that intensive collecting could actually have exterminated the Large Blue, which occured in minute numbers prior to its extinction from other causes.

Certain British lepidopterists have taken an exaggerated stance in this issue. Sheldon's primary reason for convening a conservation committee (Sheldon, 1925) was his concern over avaricious collectors. When the descendent of this group, the Joint Committee for the Conservation of British Insects, finally adopted a collecting policy a half-century later it was a moderate and workable document which forbade collecting altogether only for the Large Blue.

The cautious view still persists, however. In a recent article addressing "Trade threats to butterflies," Owen (1974) estimated that 20 species of British butterflies are threatened by the activities of dealers and collectors—eight more than the Joint Committee reckons threatened from all causes. Owen failed to document his claim that collectors will account for a "needless slaughter" of British butterflies, unless bans on collecting and trade are soon imposed. Morris (1976) wrote that "the blanket recommendations for prohibition of collecting butterflies in Britain advocated by Owen (are not) likely to achieve more than bitterness and resentment, based as they are on an uncritical assessment of the status of our butterfly fauna."

The complex scientific and ethical considerations of the collecting debate will not be dealt with in depth here. The long British preoccupation with this theme has still produced no more clear summary of the issue than that of Morris, just quoted, taken together with H. S. Robinson's paper of 1952, "Some suggestions on the examination of an ethical and a practical problem." Robinson considers the two critical questions of whether or not a standard ethic is possible with regard to killing insects, and whether or not populations are actually affected in the long run by collecting. He concludes that the moral arguments against collecting are circular and shallow and that intense personal scrutiny is far more useful and necessary than "pontifical condemnation of the actions of others." Based on his own experiments, he suggests that over-collecting, at least by highly criticized mercury vapor light traps, is nearly impossible to accomplish. With approval from the Insect Protection Committee, Robinson set out to trap the exceedingly local moth *Sedina buettneri* on the Isle of Wight as effectively as possible. His experiments failed to make a serious dent in the population; he calculated that the most liberal proportion of the population they *could* have taken in the week of experiments would have been one insect in every 500 present.

Whether the debate now ameliorates or grows more intense, one thing that is certain is that butterfly awareness in Great Britain—consumptive and appreciative—is very high, higher perhaps than anywhere else. This fact lends tremendously to the success of butterfly habitat conservation.

L. Hugh Newman, in his book *Create a Butterfly Garden* (1967), instructed people in the techniques of managing small-scale butterfly reserves. Owen (1975) demonstrated that gardens throughout Britain constitute a vast collective habitat. Greater and greater butterfly awareness means that fewer and fewer British gardeners will stick to the precepts of "tidiness" which make gardens unfit for a variety of species. A patch of nettles in the rear of a garden will nurture breeding populations of three striking nymphalines; and a gardener who purposefully leaves nettles for Peacock butterflies may also work for his or her County Naturalists' Trust to save a meadow for a rarer species in the countryside.

British butterfly awareness has reached its apex in a place in Northern Ireland, a part of Great Britain not heretofore mentioned. There, local lepidopterists have collaborated with the Forestry Commission to establish one of the first butterfly interpretive centers in the world. George Henry Heal (1973) described the project, which is known as the Drum Manor Butterfly Garden. Through vegetative manipulation, providing larval hosts and nectar sources as well as numerous micro-environments, an old walled Irish country garden has become a habitat for a diverse and abundant native butterfly fauna. Visitors typically encounter far more wild butterflies (they are not confined) than they would elsewhere in the countryside. The prolific, colorful display helps to fix their interest, and certainly makes them more aware of butterflies.

Butterfly interpretation of a high quality also takes place in Britain in the Lake District National Park in England and Pembrokeshire National Park in Wales, through the use of published pamphlets; in Woodwalton Fen National Nature Reserve, with exhibits in a beautiful thatched bungalow which used to be an entomologists' retreat; and at Worldwide Butterflies in Dorset, a commercial concern, where elaborate displays of livestock, a silk farm and other sophisticated educational materials greet the visitor. The advanced butterfly awareness of the British seems unlikely to decline.

That the British people embrace and recognize their Lepidoptera resource may be directly responsible for the relatively advanced state of active butterfly and moth conservation in that country. As a part of a larger countryside ethic, it is evident in the outstanding amenity yet retained in a country the size of California which supports more than 60 million people. Much butterfly and moth habitat has been secured in the National Nature Reserves, National Trust properties and County Trust refuges. More is relatively safe in national parks, Sites of Special Scientific Interest, commons and other forms of reserved, withdrawn, zoned or recognized land. Still, statutory protection of habitat does not guarantee against policy change, and the admirable system of cooperation, which works so well much of the time in Britain, cannot ascertain the actions of landowners. Locating the organisms, setting aside their habitat and then managing it according to genuine ecological understanding are all arts which have developed to their highest degree in Great Britain. But the pressure of population is inexorable; the process of conservation cannot rest. Great Britain is the example to the world in this somewhat esoteric endeavor. To remain so, with such pressures, will require persistence.

The degree of difficulty with which rare lepidopterans may be preserved, and the certainty of some extinctions, was expressed by Ford (1967), following his discussion of a number of moth extinctions which have occurred in Britain already: "There can be little doubt how in the near future we shall treat some of the butterflies and moths, in common with other animals and with plants which grace and glorify the English landscape to-day. We

shall destroy them."

Let us hope that the kinds of programs, actions and attitudes described in the following pages may alter that conclusion.

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Note: Readers should also see the following three papers published in *Atala* Volume 6, Numbers 1-2, 1978(81):

Moore, Norman W. Insect Conservation in Britain: National Nature Reserves.

Morris, Michael G. Insect Conservation in Britain: Ecological background and Voluntary effort.

Thomas, J. A. Insect Conservation in Britain: Some case histories.

These papers were part of the proceedings of the Fifteenth International Congress of Entomology symposium on "Endangered Insects of the World." Due to the much-delayed publication of these proceedings, some of the contents have been overtaken by events; in large part, these are updated in the present issue. Nonetheless, these earlier papers furnish additional valuable introductory information for this subject.

The Joint Committee for the Conservation of British Insects

M. G. Morris (Honorary Secretary)

Institute of Terrestrial Ecology, Furzebrook Research Station, Wareham, Dorset BH20 5AS, England

Introduction

It is always fascinating to compare and contrast similar, or ostensibly similar, organisations which have developed in different countries and to attempt to read into those comparisons differences in national attributes or approaches. The success of the Xerces Society provides an encouraging example and a valuable set of lessons for insect conservationists in Great Britain. Their own Joint Committee for the Conservation of British Insects (JCCBI) reflects, perhaps, the more conservative characteristics of the British. Certainly, the JCCBI needs to learn from the Xerces Society if the tempo of insect conservation in the United Kingdom is to be maintained.

Origins

The JCCBI is the successor to the Insect Protection Committee, later the Conservation Committee, of the Royal Entomological Society of London. The Society's Committee was founded as long ago as 1926 and did useful, if rather low-key, work up to June 1968. The Committee was particularly associated with the well-known reintroduction and maintenance of the Large Copper butterfly (*Lycaena dispar*) at Woodwalton Fen, Huntingdonshire, from 1926 onwards. By 1968, however, it was evident that a committee of one Society, even one so preeminent as the Royal Entomological Society of London, was an inappropriate body to coordinate insect conservation on the voluntary wing of the conservation movement, and the Society took the lead in forming a new, more representative committee, the JCCBI, which was founded on 21 June 1968 and held its first meeting on 1 November of the same year.

Constitution

The full members of JCCBI are those appointed by the national entomological societies (Royal Entomological Society of London, British Entomological and Natural History Society, Amateur Entomologists' Society and British Butterfly Conservation Society), and a number of regional representatives invited to serve by the Committee itself. Between them, the regional representatives cover the whole of the United Kingdom. Observers from the Nature Conservancy Council, Forestry Commission and Agricultural Development Advisory Service—all of which would be classified as federal agencies in the USA—attend meetings but have no formal vote. There is provision for full membership of a representative of the Royal Society for Nature Conservation, but this place is at present unfilled. The members of the Committee are, in general, chosen for their interest in and knowledge of insect conservation.

Objectives

The JCCBI has seven main objectives in its terms of reference and these may be summarised as the continual review of the status of threatened species, recommending and initiating conservation measures, support of other national and international conservation bodies (including, for instance, the Lepidoptera Specialist Group of IUCN's Survival Service Commission), and provision of a forum for consideration of any topic on the conservation of insects. The Committee has formally stated its intention of promoting the advancement of entomological science, as far as that is compatible with its primary aims.

Meetings

The full Committee meets regularly twice a year to consider a wide range of problems and issues. Special meetings, for instance to consider imminent legislation on wildlife conservation, are held as required. The Committee is fortunate in being able to call on the services of the Royal Entomological Society of London, and of having the privilege of meeting in the Society's Rooms.

Achievements

When societies or committees look back, there is a strong temptation to say "if only. . . ", or to dwell on missed opportunities. Members of the JCCBI are not alone in having such thoughts, but they are accompanied by a recognition of some achievements, particularly in those areas which are difficult to define, such as "awareness" and "morale".

The 'Code'

Perhaps the most widely-known of the Committee's successes is the 'Code for Insect Collecting', published in 1972 with the support of the World Wildlife Fund, and, much more importantly, accepted and endorsed by all the national entomological societies. Like all good guides for conduct, the 'Code' does not please everyone in all its particulars, but the fact that it has been so widely accepted promises well for insect conservation in Britain, and also demonstrates the fundamental interest of field entomologists in preserving wildlife for future generations.

"A CODE FOR INSECT COLLECTING

This Committee believes that with the ever-increasing loss of habitats resulting from forestry, agriculture, and industrial,

urban and recreational development, the point has been reached where a code for collecting should be considered in the interests of conservation of the British insect fauna, particularly Macrolepidoptera. The Committee considers that in many areas this loss has gone so far that collecting, which at one time would have had a trivial effect, could now affect the survival in them of one or more species if continued without restraint.

, The Committee also believes that by subscribing to a code of collecting, entomologists will show themselves to be a concerned and responsible body of naturalists who have a positive contribution to make to the cause of conservation. It asks all entomologists to accept the following Code in principle and to try to observe it in practice.

1. COLLECTING—GENERAL

1.1 No more specimens than are strictly required for any purpose should be killed.

1.2 Readily identified insects should not be killed if the object is to 'look them over' for aberrations or other purposes: insects should be examined while alive and then released where they were captured.

1.3 The same species should not be taken in numbers year after year from the same locality.

1.4 Supposed or actual predators and parasites of insects should not be destroyed.

1.5 When collecting leaf-mines, galls and seed heads never collect all that can be found; leave as many as possible to allow the population to recover.

1.6 Consideration should be given to photography as an alternative to collecting, particularly in the case of butterflies.

1.7 Specimens for exchange, or disposal to other collectors, should be taken sparingly or not at all.

1.8 For commercial purposes insects should be either bred or obtained from old collections. Insect specimens should not be used for the manufacture of 'jewellery'.

2. COLLECTING—RARE AND ENDANGERED SPECIES

2.1 Specimens of Macrolepidoptera listed by this Committee (and published in the entomological journals) should be collected with the greatest restraint. As a guide, the Committee suggests that a pair of specimens is sufficient, but that those species in the greatest danger should not be collected at all. The list may be amended from time to time if this proves to be necessary.

2.2 Specimens of distinct local forms of Macrolepidoptera, particularly butterflies, should likewise be collected with restraint.

2.3 Collectors should attempt to break new ground rather than collect a local or rare species from a well-known and perhaps over-worked locality.

2.4 Previously unknown localities for rare species should be brought to the attention of this Committee, which undertakes to inform other organisations as appropriate and only in the interests of conservation.

3. COLLECTING—LIGHTS AND LIGHT-TRAPS

3.1 The 'catch' at light, particularly in a trap, should not be killed casually for subsequent examination.

3.2 Live trapping, for instance in traps filled with egg-tray material, is the preferred method of collecting. Anaesthetics are harmful and should not be used.

3.3 After examination of the catch the insects should be kept in cool, shady conditions and released away from the trap site at dusk. If this is not possible the insects should be released in long grass or other cover and not on lawns or bare surfaces.

3.4 Unwanted insects should not be fed to fish or insectivorous birds and mammals.

3.5 If a trap used for scientific purposes is found to be catching rare or local species unnecessarily, it should be re-sited.

3.6 Traps and lights should be sited with care so as not to annoy neighbours or cause confusion.

4. COLLECTING—PERMISSION AND CONDITIONS

4.1 Always seek permission from landowner or occupier when collecting on private land.

4.2 Always comply with any conditions laid down by the granting of permission to collect.

4.3 When collecting on nature reserves, or sites of known interest to conservationists, supply a list of species collected to the appropriate authority.

4.4 When collecting on nature reserves it is particularly important to observe the code suggested in section 5.

5. COLLECTING—DAMAGE TO THE ENVIRONMENT

5.1 Do as little damage to the environment as possible. Remember the interests of other naturalists; be careful of nesting birds and vegetation, particularly rare plants.

5.2 When 'beating' for lepidopterous larvae or other insects never thrash trees and bushes so that foliage and twigs are removed. A sharp jarring of branches is both less damaging and more effective.

5.3 Coleopterists and others working dead timber should replace removed bark and worked material to the best of their ability. Not all the dead wood in a locality should be worked.

5.4 Overturned stones and logs should be replaced in their original positions.

5.5 Water weed and moss which has been worked for insects should be replaced in its appropriate habitat. Plant material in litter heaps should be replaced and not scattered about.

5.6 Twigs, small branches and foliage required as foodplants or because they are galled, e.g. by clearwings, should be removed neatly with secateurs or scissors and not broken off.

5.7 'Sugar' should not be applied so that it renders tree-trunks and other vegetation unnecessarily unsightly.

5.8 Exercise particular care when working for rare species, e.g. by searching for larvae rather than beating for them.

5.9 Remember the Country Code!

6. BREEDING

6.1 Breeding from a fertilised female or pairing in captivity is preferable to taking a series of specimens in the field.

6.2 Never collect more larvae or other livestock than can be supported by the available supply of foodplant.

6.3 Unwanted insects that have been reared should be released in the original locality, not just anywhere.

6.4 Before attempting to establish new populations or 'reinforce' existing ones please consult this Committee."

Schedules of Threatened Species

The Committee has produced and published lists of species, in all the popular groups, which it considers to be "at risk". These lists have been used by legislators and administrators in formulating measures for the statutory protection of endangered species. They also are the precursors of the "Insect Red Data Books" currently being produced. The Committee's members are well represented on the Committee which is defining criteria and selecting species for inclusion in the "RDB".

"Dead Wood"

With the cooperation of the Devon Trust for Nature Conservation, the Committee produced a booklet, written by A. E. Stubbs, on the conservation value of dead and dying wood, particularly in old forest areas, for the conservation of insects (principally Coleoptera and Diptera). This booklet has continued to contribute to the recognition of this neglected habitat type, which has also recently received support from lichen enthusiasts, whose plants grow on the trunks and branches of old trees.

Surveys

One of the most valuable activities of the Committee is its initiation of, or support for, surveys of species which are thought to be endangered. Surveys, some supported financially by the World Wildlife Fund, have been made of the Chequered Skipper (*Carterocephalus palaemon*), Adonis Blue (*Lysandra bellargus*), Glanville Fritillary (*Melitaea cinxia*), rare and threatened dragonflies (Odonata), amongst others. The appointment of Dr. J. A. Thomas as Surveys Officer in 1979 has rejuvenated the Committee's survey effort, as Dr. Thomas, with his expertise in butterfly population ecology, has been able to direct the Committee's efforts in collaboration with other bodies which also undertake surveys.

The Watchdog Role

The single most important everyday activity of the Committee is in recognising, anticipating where possible and evaluating threats to sites or species. Whilst on its own the Committee is unable to actively oppose threatening developments, it has been able to add its view and its expertise to those other bodies.

Liaison

Conservation in Britain, particularly on the voluntary wing, is wedded to the "hat system". The same people represent different organisations in a variety of permutations by "wearing different hats". Although, formally, insect conservation is not well organised in Britain because the same people serve on different bodies, contact and interchange of ideas and information are usually adequate and the system works.

Professionals and Amateurs

Inasfar as these obsolescent terms continue to have meaning, the JCCBI is weighted towards the professionals, not from choice but because those who are paid to do entomology find it easier to attend meetings. The Committee is very anxious to improve the representation of amateur entomologists—in general the true field workers—among the ranks of its members.

The Future

The JCCBI has not made the progress it expected to make in the last five years. Pressure of other work on the few members willing or able to actively manage its affairs has reduced progress. There has been a dearth of keen, young, conservation-minded entomologists, perhaps because the Committee has not advertised itself successfully. The Committee has an important role to play in conservation and in entomology in Britain, and there is a renewed determination amongst its members to play this role successfully. Plans are being laid to place the finances of the Committee on a surer footing, and the recruitment of "new blood" to the Committee may have the desired effect. Whatever the success of the Joint Committtee for the Conservation of British Insects in the future, there will be no lack of problems to solve. The example of the Xerces Society will be an encouragement in the years ahead.

The Biological Records Centre and Insect Recording

John Heath and Paul T. Harding

Institute of Terrestrial Ecology, Natural Environment Research Council, Monks Wood Experimental Station, Abbots Ripton, Huntingdon, Cambridgeshire PE17 2LS, England

Naturalists have been interested in the occurence of the flora and fauna of Britain and Ireland since at least the 17th century. The study of the occurrence of the flora and fauna, and particularly of distributions, has caught the imagination and enthusiasm of many naturalists, both amateur and professional. The Biological Records Centre (BRC) at the Monks Wood Experimental Station of the Institute of Terrestrial Ecology has been developing a role to service schemes recording the occurrence of the flora and fauna of the British Isles.

The BRC was set up in 1964 by Dr. F. H. Perring after the completion of the Botanical Society of the British Isles' survey of the vascular plant flora (Perring & Walters, 1962). The techniques of recording, data handling and data use, pioneered by the Botanical Society of the British Isles, were applied to several other groups of organisms. As data handling technology has been advanced and the wider potential of the recording scheme principles has been realised, many more groups have been covered by national recording schemes.

National Recording Schemes

Each recording scheme differs in some way from the rest, but in essence each attempts to organise naturalists who are willing to contribute records to submit their records in a standard form. The simplest type of record is of a species at a locality (identified by a national grid reference and usually by a place name), on a date, recorded by a named individual.

The pioneer scheme was that of the Botanical Society of the British Isles , for vascular plants, begun in 1954. This scheme, as proposed by Professor A. R. Clapham, was to record the presence of plants in the 10 kilometer squares of the national grid, rather than in the more usual but much larger Watson/ Praeger vice-counties, or by localities as had been done by some continental workers. Many of the records received by the Botanical Society of the British Isles scheme were summarised in the form of records for a 10 kilometer square. The limited usefulness of such summarised records was soon realised by the BRC and other recording schemes were eventually encouraged to record in detail and then to summarise the data at a later date.

Each scheme has at least one central organiser responsible for the gathering of records from naturalists or from regional organisers dealing directly with the naturalists in their area. Many of these recording schemes have been set up and are run by "amateur" societies or by private individuals. Others are run as projects by individuals at academic or research organisations or in museums.

The Role of the Biological Records Centre

BRC acts as a focus for the recording schemes and as a depository for data collected by them, to form a national data bank and archive of the occurrence of the flora and fauna in the British Isles.

The organisers of national recording schemes are helped with advice on the setting up and operation of their schemes, with the provision of recording cards and other stationery, with means of publicising their schemes, and instructions for recorders. In addition, guides to critical species have been published for certain difficult groups (Heath, 1969 and others).

Once sufficient data have been accumulated by a scheme they are deposited with BRC, in the national biological data bank. Once deposited, distribution maps can be prepared, and it is these maps that most recording scheme organisers see as the main objective of their scheme. It is usual for preliminary or provisional distribution maps to be published and made available to the contributors to the relevant scheme.

Output from the data bank can be in the form of the now well known 10 kilometer square "dot" distribution maps (Figure 1) or listings of species for localities or of localities for species. The data are also available for use in analyses in conjunction with other data sets, such as of environmental factors. This aspect of the use of the BRC data bank is currently being developed within the Institute.

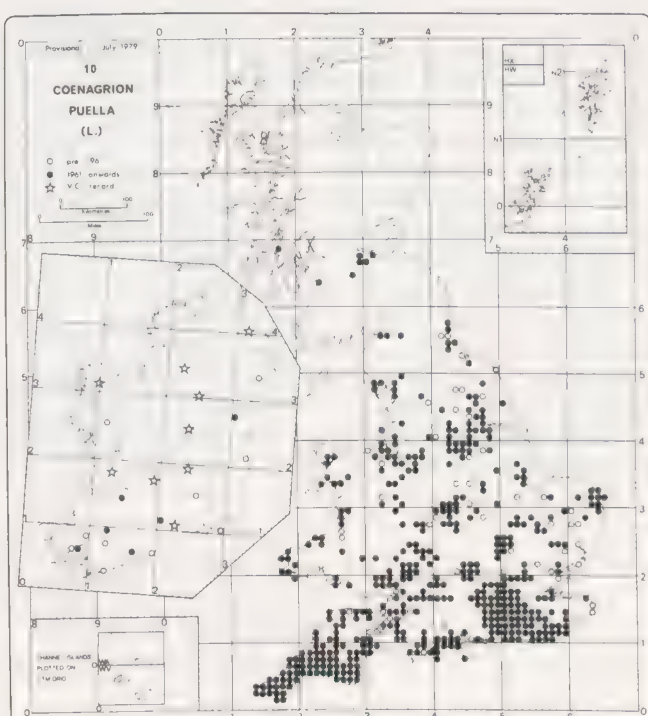

Figure 1. Ten kilometre square "dot" distribution map.

The data bank exists in two forms. Summarised data are stored on the IBM 360/195 computer at the Rutherford Laboratory. The "raw" data, usually on one of three types of recording card, from which the summaries were made, are stored by taxonomic groups and arranged by 10 kilometer squares in card drawers at BRC.

Data can be made available on request to any serious enquirer, subject to some obvious restrictions, e. g. on data for rare and endangered species, or where the data will be exploited for commercial gain. Occasionally BRC receives enquiries or requests for information which are impractical because the enquirers are unaware of the quantity or quality of data involved or the complexity of their enquiry.

The BRC has a special relationship with the Nature Conservancy Council and supplies it with information, particularly on the occurrence of rare and endangered species, which can be used in planning the nation's official policy for wildlife conservation. Voluntary conservation bodies such as county naturalists' trusts and their "parent body", the Royal Society for Nature Conservation (of which Dr. Perring is now General Secretary), local biological records centres and national and local natural history societies all enjoy useful collaboration with BRC.

Input on the British flora and fauna to various international surveys is made through BRC, including the Atlas Florae Europeae project and the European Invertebrate Survey (Heath, 1971a).

Other Forms of Recording

It would be unrealistic to infer that biological recording does not exist in Britain without the involvement of the national recording schemes and/or the BRC. Most data coming to BRC have a bias to geographical occurrence; comparatively few data are available on the habitats of species. This work, mainly of amateur naturalists, on geographical distribution supplements autecological research at academic and research organisations. However, the lengthy and labour-intensive studies of single species can necessarily only cover a limited number of species, whereas national recording schemes are often able to draw upon large numbers of recorders. For example, between 1968 and 1972 over 10,000 ornithologists provided records of the birds breeding in Britain and Ireland in a survey organised by the British Trust for Ornithology and the Irish Wildbird Conservancy.

Although data from the national recording schemes are available to research workers wishing to make autecological studies, in some cases the results of neither a national recording scheme nor autecological studies can answer a particular problem. In such a case a special survey has to be set up. The butterfly monitoring scheme (Pollard, 1979 and this issue) seeks to examine the fluctuations in numbers of butterflies at a number of localities by regular and systematic sampling (by observation). The British Trust for Ornithology has organised several special national surveys of birds and their habitats. Following that lead, schemes have been set up for some little-known invertebrate groups, to examine their habitat preferences as well as their geographical distribution. Also within the Institute of Terrestrial Ecology, the Phytophogous Insect Data Bank provides information, mainly derived from published sources, on plant-eating insects and their host plants.

As was mentioned above, the maps themselves are seen by many as the main objective of the scheme. Certainly these provide a starting point for conservation and biogeographical investigations, since they display graphically changes in distribution over time. Of course, this presupposes that maps are updated from time to time, and that different map symbols are used for old and recent records; both are usual practice. It has often been said that one cannot conserve something until one knows where it is, and these maps furnish that critical element of situation. To date, invertebrate atlases have been published for a number of groups (Heath, 1971b). Following the first, for butterflies (Heath, 1970), subsequent atlases have depicted the known ranges of some additional Lepidoptera, Odonata, Orthoptera, ants and bumblebees among Hymenoptera, Siphonaptera, Isopoda (woodlice), pseudoscorpions and land and freshwater mollusks. The immense job of recording the occurrence of the British invertebrate animals will continue, drawing upon our unusually large pool of amateur and professional biologists and their field records. It is to be hoped that others will continue to explore the uses of applied biogeography as a conservation tool.

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Editor's note: Atlases of invertebrates and other publications of the Biological Records Centre, including an attractive pamphlet entitled "Biological Records Centre", may be obtained from the Publications Officer, Institute of Terrestrial Ecology, 68 Hill's Road, Cambridge, CB2 1LA England. Write for prices.)

British Red Data Book - Insects

John Heath

Institute of Terrestrial Ecology, Natural Environment Research Council, Monks Wood Experimental Station, Abbots Ripton, Huntingdon, Cambridgeshire PE17 2LS, England

A criteria and species selection committee consisting of members of the Institute of Terrestrial Ecology, Nature Conservancy Council, Joint Committee for the Conservation of British Insects and the British Entomological and Natural History Society together with appropriate experts, with Dr. M. G. Morris as Chairman and J. Heath as Secretary, has drawn up a list of candidate species. These species have been placed in the appropriate IUCN categories and data sheets are being prepared for those in categories 1 (Endangered) and 2 (Vulnerable).

The following table gives the number of species in those orders considered.

Order	Total no. of species (approx.)	Endangered		Vulnerable		Rare		Out of Danger	Appendix species i.e. extinct before 1901	Notes
		No.	% of Total	No.	% of Total	No.	% of Total			
ODONATA	44	5	11	5	11	5	11	-	-	
ORTHOPTERA	28	3	11	2	7.1	3	11	-	-	
LEPIDOPTERA:										Full data sheet entries will be required for the Endangered and Vulnerable species except for the Coleoptera and Diptera, where listings will be made under Endangered or Vulnerable habitat.
Rhopalocera	70	2	2.9	4	5.7	5	7.1	1	-	
Heterocera	2,500	33	1.3	17	0.7	59	2.4	-	-	
HYMENOPTERA	6,500	23	0.35	6	0.09	16	0.25	-	19	
HEMIPTERA	1,800	14	0.78	5	0.28	51	2.8	-	5	
COLEOPTERA	4,000	130	3.3	95	2.4	190	4.7	-	28	
DIPTERA	6,000	183	3.1	245	4.1	434	7.2	-	-	
TRICHOPTERA	192	4	2.1	1	0.52	35	18	-	-	
TOTAL	21,134	397	1.9	380	1.8	798	3.8	1	52	

SUMMARY OF CANDIDATE SPECIES

The butterflies are as follows:

Category 1 - Endangered
- *Maculinea arion* (probably extinct)
- *Carterocephalus palaemon* in England

Category 2 - Vulnerable
- *Papilio machaon*
- *Nymphalis polychloros*
- *Argynnis adippe*
- *Melitaea athalia*

Category 3 - Rare
- *Carterocephalus palaemon* in Scotland
- *Thymelicus acteon*
- *Hesperia comma*
- *Melitaea cinxia*
- *Erebia epiphron*

Category 4 - Out of danger
- *Strymonidia pruni*

Category 5 - Endemic
- *Hipparchia semele thyone*
- *Plebejus argus caernensis*

Why Did the Large Blue Become Extinct in Britain?

Jeremy Thomas

Institute of Terrestrial Ecology, Furzebrook Research Station, Wareham, Dorset BH20 5AS, England

Abstract

In 1979 the Nature Conservancy Council revealed that the large blue butterfly *Maculinea arion* was probably extinct in Britain, despite much research and valiant efforts to save it. The author, a member of the Institute of Terrestrial Ecology, who since 1972 has been engaged full time on the research and conservation work for the butterfly, tells the story as it is now known.

It is believed that the large blue butterfly became extinct in Britain in 1979. It is over 50 years since any British butterfly was lost, but the demise of the large blue is particularly sad because it was one of our most attractive species and because it has a particularly interesting life cycle. Eggs are laid on thyme *Thymus praecox*, on which the young larvae feed, but older larvae are carried by red (*Myrmica* spp.) ants to their underground nests, where they live for nine months, feeding on ant grubs.

The large blue has always been a local species in Britain, having been recorded from only about 90 sites in the past 150 years. These colonies declined over much of that period, but the butterfly still occurred on at least 30 sites in the early 1950s in the Cotswolds, Somerset, Devon and Cornwall. Some of these held large populations. Unfortunately, a severe decline occurred in the next ten years, and by the mid 1960s only four colonies were known. These became extinct in 1967, 1971, 1973 and 1979.

About half of Britain's large blue colonies were destroyed by fundamental changes to their sites, such as by ploughing, afforestation, urbanisation, and quarrying. More would have been destroyed but for the action of conservationists, whose exertions to save the large blue have been great, extending over 40 years and culminating, in 1962, in the formation of a Joint Committee for the Conservation of the Large Blue Butterfly to coordinate projects. Unfortunately, despite the many measures that were taken, the large blue continued to decline as rapidly on nature reserves as on other sites because, as is now apparent, the precise environmental conditions needed for a viable colony were not understood, and subtle adverse changes were occurring on sites, unrecognised and unchecked.

The Research

By 1972 it was clear that a greater understanding of the ecology of the large blue was needed if there was to be any hope of saving it. Full time research was started by the Nature Conservancy, and continued with the foundation of the Institute of Terrestrial Ecology. This revealed some of its requirements and showed grave and increasing deficiencies in the habitat of remaining and former sites. In particular, it was found that only one species of ant, *Myrmica sabuleti*, was a suitable host for a colony, and that survival was so poor in nests of the other common grassland *Myrmica*, *M. scabrinodis*, that a colony was unlikely to survive if that ant predominated. It was also found that the status of these ants was mainly determined by the intensity of grazing. *M. sabuleti* is confined to a very close-cropped sward on large blue sites, and is rapidly replaced by the unsuitable *M. scabrinodis* if grazing is only slightly relaxed. If grazing is abandoned, almost all *Myrmica* nests disappear rapidly, especially on acid soils if scrub invasion is also unchecked. In contrast, thyme persists in a wide range of sward heights, and flourishes under grazing regimes that support either *M. sabuleti* or *M. scabrinodis*. After many years it, too, declines on ungrazed sites.

An analysis of the habitat of all former and existing large blue sites in Britain showed that, with the exception of the last site, none was being grazed intensively enough to support the high densities of *M. sabuleti* that are needed, although several were being lightly grazed and had an abundance of thyme and *M. scabrinodis*. Most had been entirely abandoned and had lost the majority of their ants. This relaxation in grazing occurred on most sites after the mid 1950s, when myxomatosis reduced rabbit populations and when the changing economics of agriculture gave a poor return from grazing 'unimproved' sites to the required intensity. Thus, because of changing land management, the specialised conditions needed by the large blue were unlikely to be produced as a by-product of agriculture after the mid 1950s, and its survival as a British species was only likely to continue on nature reserves. Unfortunately, these were acquired rather late to save this insect, and there was a further delay in obtaining the knowledge of how best to manage them.

The last British colony became extinct for other reasons than habitat destruction or undergrazing. This site was maintained in a suitable condition (through giving generous terms to the tenant farmer) such that a population of the large blue would be expected to increase in most years, as indeed occurred continuously from 1964 to 1973. Unfortunately, the breeding area was so small that it could not support a population large enough to withstand an occasional sequence of adverse events. Such a sequence occurred in the mid 1970s. By 1973, the population had increased so much that the low capacity of the site was exceeded and severe overcrowding occurred, causing heavy extra mortalities and reducing the population from about 300 to 100 adults in 1974. (These mortalities mainly occurred in ants' nests, with up to 40 larvae entering a single nest. Most nests can support only one large blue, and in cases of overcrowding all the

This article was originally published in *Oryx* (1980) 15: 243-247, and is reprinted herein in its entirety with the exception of the illustrations.

larvae died). In perhaps 14 out of 15 years, the population would increase after this under the then habitat conditions, but, unfortunately, before this could occur, severe droughts in 1975 and 1976 further reduced the colony, so that only about 16 adults emerged in 1977. Extreme summer drought can be very harmful to egg-laying and to the condition of ant nests, but has only occurred at a damaging intensity about once every 25 years in the present century up to 1975.

By 1976, enough was known of the requirements of the large blue to see that its last site was probably too small to support a colony indefinitely. Plans were made to enlarge and improve the breeding areas so that they could eventually support 5000 adult large blues before overcrowding occurred. This worked well, and by 1978 the carrying capacity had already increased from about 300 to about 700 adults. Experiments showed that, if only this had been done before 1973, the population would have spread into these adjoining areas and would probably have increased in that year, instead of experiencing the most severe annual decline yet recorded.

Despite the improvement to the last site, no recovery of the large blue could be confidently predicted after 1977, even given 'average' years, because adult numbers had fallen to so low a level that inverse density-dependent and chance factors could also be important. For example, by chance in 1977 probably only five (possibly six or seven) individuals of the estimated population of 16 adults were females, although there are usually almost equal numbers of the two sexes. This dearth of females was compounded by the fact that the last one (probably two) females to emerge failed to mate because all the earlier-emerging and short-lived males had already died. Thus, probably only about 25 percent of the 1977 population started the adult period as fertilised females, instead of the usual proportion of about 50 percent of the population when numbers are higher.

For these reasons, few eggs were laid in 1977 and it was predicted that the emergence of large blues in 1978 would be even lower than in 1977 and even more liable to extinction through inverse density and chance effects. The Nature Conservancy Council and the Joint Committee therefore decided to rear the 1978 adults in semi-captivity, in an eleventh hour, 'one-off' attempt to increase numbers to a viable level. It was hoped to achieve this by prolonging the lives of males, thus increasing the chances of females being mated; by increasing the number of eggs laid per female by caging them over thyme; by rearing these eggs in captivity; and by reintroducing the young larvae to *M. sabuleti* nests on the site.

The fears that prompted this operation were realised in 1978 when only five adults (two females, three males) emerged over the long period of 31 days. The large blue has a short life expectancy in the wild, and the extended emergence meant that there was a less than 50 percent chance that even one female would have paired in the wild through no male being alive at the critical times, and only a 7 percent chance that both would have paired. Thus the colony would probably have become extinct in 1978 had no action been taken. Instead, all five adults were kept alive for much longer than their natural lifespans, but only one female paired. This was because no male was in peak condition when the other female was receptive. However, by the end of the season, 59 larvae had been introduced to *M. sabuleti* nests on the site, which is about five times the average number produced from one female in the wild. It was thought that these would still produce too few adults in 1979 for safety, although numbers would be considerably higher. It was decided, therefore to repeat the operation in 1979 in a second attempt to increase numbers to a viable level.

In 1979, 22 adults emerged, representing an exceptionally high survival in ant nests and indicating that the site was still as good as it had ever been for this species. Unfortunately, these adults failed to pair and only a few sterile eggs were laid by virgin females. The reason for this failure is not understood, although it is not thought to be caused by inbreeding. A more likely explanation is that the pairing of captive butterflies, which is always difficult and unpredictable, sadly, was unsuccessful on this occasion. This possibility was recognised before the operation, but was considered to be a lesser danger than the near certainty of extinction if no action was taken.

Thus what is believed to be the last colony of the large blue in Great Britain became extinct in 1979. Since this news was released, there have been a large number of sightings reported from all parts of the British Isles, as have indeed been received every year. Unfortunately, none seems to be very likely and most can be immediately dismissed, mainly as misidentifications of the common blue *Polyommatus icarus*. There is still a faint hope that some colony exists, but this is unlikely in the light of the many surveys that have been made and the rarity of suitable habitat occurring, by chance, as a result of modern farming practices. However, another survey will be made of all possible sites in 1980.

In the meantime, former sites will be maintained or improved to provide suitable habitat conditions. If no British colony is discovered in the next few years, an introduction using continental stock may be considered.

The Lessons

Much has been learnt from the history of the conservation of the large blue, despite its disappointing outcome. Its decline to possible extinction was recognised at least 100 years before the event, and active conservation started more than 40 years ago. Since then, many measures have been taken, of which only a few have been described in the literature. These involved a very large expenditure of enthusiasm, manpower, and money, yet the butterfly still became extinct. With hindsight, it is clear that the butterfly could almost certainly have been saved, if only the measures that were started in the mid 1970s had been taken five or more years earlier. The reason why they were not is entirely due to the fact that the butterfly's ecological requirements were not understood until after they had been studied intensively; this did not occur until the 1970s. The will and resource needed to save the large blue were certainly available in the 1960s, and probably earlier (when the required action would also have been much easier and cheaper). Instead, most of the measures that were taken at that time can now be shown to have been irrelevant or actually harmful to the butterfly's needs. Some measures taken were, on the other hand, beneficial (e. g. discovering colonies, preventing ploughing of sites, deterring collectors) but these did not rectify the main adverse changes.

This account is not intended as a criticism of early conservation efforts. There were few precedents for conserving an insect when the first measures were taken, and most were pioneering and enlightened for their time. It was only after they had been tried, and were found wanting, that it became apparent that the specialised requirements of a rare insect were unlikely to be guessed from a mere knowledge of the life cycle, and were only likely to be revealed as a result of full-time research. Having

learnt this lesson, it is hoped that more will be learnt about the requirements of other endangered species at an earlier stage in their decline, so that the resources now available can be used more constructively. This applies to both common and rare species, but is a more urgent problem for the latter. Experience from the large blue suggests that the sooner this is done, the easier and quicker will be the research and the measures needed, and success will be more probable, and more cheaply attained.

Butterfly Year, 1981-82

J. A. Thomas

Institute of Terrestrial Ecology, Furzebrook Research Station, Wareham, Dorset BH 21 5AS, ENGLAND

The main entomological and conservation bodies in the United Kingdom have decided to declare a national Butterfly Year. It began formally on 13 May 1981 when the Post Office issued a set of four stamps depicting British butterflies, and will continue until Summer 1982. The joint aims of Butterfly Year are to increase the public's awareness of butterflies (and other insects) and of the threats that they face, and to launch an Appeal Fund to finance conservation projects for butterflies.

Butterfly Year was conceived in order to give impetus and direction to a growing concern about the plight of butterflies in Britain. Only about 60 species breed regularly in the country, of which 5 or 6 are dependent on annual influxes of migrants from mainland Europe. It had already been widely noticed that there seemed to be fewer butterflies about in recent years, or at least fewer places where they could be found, and this general concern was heightened by the news of two probable extinctions; of the Chequered Skipper, *Carterocephalus palaemon* in 1976 (from England only, a few colonies exist in Scotland) and of the Large Blue, *Maculinea arion* in 1979 - the first such losses for at least 50 years. Unfortunately, it is now clear from recent surveys and mapping schemes that these extinctions are merely the tip of the iceburg. It seems that over three-quarters of Britain's butterflies are experiencing some sort of a decline, that at least one quarter are in severe decline, and that more national extinctions may well occur before the turn of the century if present trends continue. Against this, roughly eight species seem to be holding their own and another three may be showing a modest increase. In his monumental survey, Heath (in press) has shown that this overall decline is about par for a central or northern European country. More intensively developed nations, such as Belgium and especially Holland, are 'ahead' of the United Kingdom and have already experienced a spate of extinctions. Others, such as France, have suffered similar losses in northern areas but are still relatively rich in the south.

Public Awareness

The decline of butterflies in the UK has coincided with (and probably partly fuelled) a much greater public awareness of their intrinsic attraction, and of the pleasure of seeing them in the countryside. There has been increasingly vocal concern about the disappearance of commoner species from favourite walks, picnic spots and commons. A major aim of Butterfly Year is to increase even further the appreciation and concern for butterflies *per se*, and also to put over the fact that they do represent sensitive and conspicuous indicators of changes that may be occurring in a locality. For example, the loss of butterflies from a site may precede the loss of its wildflowers.

The formal start to Butterfly Year has already been preceded by several events designed to draw the public attention towards butterflies. The largest was a television film about the four butterflies on the new stamps, especially concentrating on *Maculinea arion*. This was coupled with a long cover article in the Radio Times (circulation 14 million copies) about butterfly conservation. The programme itself was watched by over three million viewers, in January 1981, and the response was such that it was repeated in May when the stamps were issued. Another 45 minute TV film on butterflies was transmitted in the same week. In addition, there have been several radio broadcasts and newspaper articles about butterfly conservation, and a childrens' competition has been started by the Post Office and British Museum; thousands of copies had been distributed by April 1981. However, the main publicity and promotion will occur during the Year itself. Many projects are planned, including a butterfly diary-cum-habitat competition for schoolchildren which will be run by the Post Office and WATCH. Invitations to participate will be sent to at least 12,000 schools (about one third of all schools in the UK) and another 70,000 individual forms will be distributed among WATCH members. It is expected that this competition will be judged on a popular childrens' television programme. Much other media coverage is expected, and several magazines will be featuring articles on butterfly conservation. These will reach a wide public; the National Trust's magazine alone has a circulation of over one million. It is also intended to publish a broadsheet containing advice on projects and activities, organise walks with experts, hold exhibitions in museums and galleries, present lectures and films, and persuade publishers and booksellers to display relevant books, posters and other materials. Butterfly Year merchandise (badges, stickers, embossed pencils, T-shirts, etc.) will be sold through conservation and other outlets. All in all, a large proportion of the 55 million inhabitants of the UK should be made aware of the attraction of butterflies and of their current plight, and it is hoped that this will spur even greater demand for their conservation.

Appeal Fund

The other aim of Butterfly Year is to promote the conservation of butterflies (and other insects) more positively than in the past, for they have received far less attention than, say, birds and flowers, yet their needs are, if anything, greater. In fact, butterfly conservation has already been developing rapidly in Britain over the past decade, but it is hoped that these projects will be greatly expanded in the 1980s. Many of these will be expensive, and an Appeal Fund is being launched in order to help finance them. Some of the major projects will involve:

a) Obtaining Nature Reserves

It is now clear that the survival of some species of butterfly in

(continued on page 54)

The British Butterfly Conservation Society

John Tatham, Chairman

Tudor House, Quorn, Leicestershire LE12 8AD, England

The British Butterfly Conservation Society is the one private, charitable organization in the United Kingdom devoted to the conservation of the British butterfly fauna. The Society was originally formed in 1968 by the late Thomas Frankland and Julian Gibbs. The idea was Mr. Frankland's: both were keen amateurs who felt that little had been done to co-ordinate or stimulate work for the conservation of British butterflies, particularly on behalf of the public at large. They decided that they themselves should make a move, using their experience of other such society work. They provided the funds to start the British Butterfly Conservation Society (BBCS), and further support was provided by the Frankland Trust.

In 1971 a new Committee was elected with John Tatham as Chairman and Robert Goodden as Vice-Chairman. The membership at that time was a little over 200; since then the Society has expanded to its current strength of no less than 1800 members, many of whom are actively engaged in carrying out habitat surveys for the Society.

The Society's Objects are as follows:

1. To save from extinction or protect all species of British butterfly, by conserving them in the wild by such means as are available or by breeding numbers in captivity and, where practicable, re-introducing them in natural habitats.
2. To sponsor further scientific study and research in conservation of these butterflies both in the wild and in captivity.
3. To foster interest generally by educating the public, and in partiular educational establishments, in problems concerning conservation of these butterflies.

In the educational area, the BBCS mounts exhibitions at various shows including large regional fairs. There is a strong Junior Section, and in many schools Junior Groups have been established under the guidance of a senior member. A panel of speakers gives presentations on conservation and, although we are primarily a British Society, we try to export our philosophy: there are members in at least twelve overseas countries.

Amongst the Society's Vice-Presidents is the noted actress Dulcie Gray, whose recent book *Butterflies on My Mind* has attracted a great deal of attention to the Society's aims and objectives, as has also Vice-Chairman Robert Goodden's *Field Guide to British Butterflies*.

The conservation of butterflies and moths is still a new science. Most of what is known of their needs for survival is based on observations made when breeding them in captivity. More work must be done in the field, and the BBCS has mounted a unique habitat survey toward this end. The survey will help determine where butterflies actually exist, but, much more importantly, should help to ascertain the many factors responsible for the distribution or disappearance of any particular species. We have established recorders for the six most endangered species, although the surveys are aimed at all of our native British butterflies.

We have found that butterflies, as one would expect, thrive in wild habitats but avoid most forms of cultivation. Grassy downlands and edges of woodland are especially favored, but the Peacock, Small Tortoiseshell, Comma and Red Admiral frequently inhabit gardens and will breed there if the area is large enough and contains their hosts (nettles). Other visitors to gardens include the Large, Small and Green-veined Whites, Brimstone, Orange Tip, Small Copper and Speckled Wood. The primary necessity for attracting them is a super-abundance of flowers that are rich in accessible nectar. The BBCS encourages making townscapes more suitable for butterflies, and recommends particularly, in order of flowering, the following nectar sources: Polyanthus, Alyssum, Aubretia, Wallflower, Thrift, Honesty, Sweet Rocket, Valerian, Bugle, Mignonette, Sweet William, Lavendar, Catmint, Phlox, Hyssop, Buddleia, Aster, Verbena, Echium, Cornflower, Heliotrope, Goldenrod, Michaelmas Daisy and *Sedum spectabile*. Wild flowers providing a good source of nectar from spring to autumn include Primrose, Pussy Willow, Dandelion, Campion, Garlic Mustard, Clover, Hawkweeds, Lucerne (Alfalfa), Ox-eye Daisy, Hemp Agrimony, Thistles, Brambles, Marjoram, Scabious and Knapweed.

Some management of wild habitats is often necessary, and working parties of the Society often lend labor to such activities. Hogweed and coarse grasses can impinge upon more desirable plants if not cut from time to time. Cocksfoot, although a valuable foodplant for some butterflies, may suppress such species as Sweet Vernal Grass, Fescues and Bents; these are not favored foodplants in themselves but form a good matrix for Birds'foot Trefoil, Horseshoe Vetch and other low-growing plants useful to butterflies.

One notable instance of habitat management concerns that great rarity, the Black Hairstreak. The larvae thrived in one of the reserves and pupated on the twigs of Blackthorn bushes. It was discovered, however, that at this stage small rodents found them at night and ate them in numbers. The solution was simple but remarkable in its effect: by scything the long grass beneath the bushes, the rodents were deprived of cover and removed themselves; pupal survivorship increased dramatically.

The Society carefully monitors proposed industrial, commercial, residential and highway developments where these threaten existing habitats of less common species. Strong representations are made to the planning authorities where appropriate, often to good effect. We work closely with local county naturalists' trusts and with the Nature Conservancy Council. Close liaison is also maintained with the Institute of Terrestrial Ecology at Monks Wood Experimental Station, Huntingdon, and with the insect recording schemes run by the Biological Records Centre of the Institute of Terrestrial Ecology, also at Monks Wood.

Currently the proposed extension of the M40 Motorway from Oxford to Warwick is under close scrutiny by the Society. The preferred route would destroy two vital areas for butterflies, and together with the Nature Conservancy Council and the Berkshire, Buckinghamshire and Oxfordshire Naturalists' Trust, representations are being made to the Secretary of State for the Environment. The Society will be represented at the Public Enquiry to be held in 1981. A reserve has been established in southwest England on land owned by the Forestry Commission, where thirty-four of the sixty-four British butterflies reside. BBCS manages this reserve.

After seven years the Society has finally persuaded the British Post Office to issue four butterfly stamps, scheduled for May 1981, and the Society's President has painted a British Swallowtail to illustrate the First Day Cover. The President, Sir Peter Scott, CBE, DSc, LL.D., has agreed to autograph a limited number of these covers for sale, the proceeds to benefit Butterfly Year, of which BBCS is a major supporter.

A West Midlands Branch of BBCS has become active, publishing its own newsletter and pursuing many of the Society's objectives more intensively on a regional scale of operations. Additional branches are likely to follow their lead.

The British Butterfly Conservation Society's Annual General Meeting is held annually on the first Saturday in March at the Victory Services Club, Marble Arch, London W2. A very warm welcome will be extended to any Xerces Society members who happen to be in London at the time. We were delighted to have Xerces' founder, Robert Pyle, with us at our 1980 Annual General Meeting and our members greatly appreciated the fascinating talk he so kindly gave on the activities of the Xerces Society. Societies such as ours have different approaches, based on the needs and opportunities in their countries of concern. But we have a great challenge in common, and no doubt a great deal to learn from one another.

(Editor's Note: Information about the BBCS, including membership and subscription to the excellent BBCS NEWS (a very full and intriguing quarterly), as well as prices for attractive BBCS T-shirts and other items, can be obtained by writing the author at the address given above.)

Note in Press: It has recently been agreed that BBCS should take over the Butterfly Recording Scheme, heretofore organized from Monks Wood Experimental Station. Roger Sutton will serve as Recorder. Roger and Linda Sutton already manage two butterfly reserves on behalf of BBCS.

(Butterfly Year continued from page 54)

the UK is only likely to occur on nature reserves, and, in some regions, this may apply to most species. Some existing reserves already support fine populations of many butterflies, including rarities, but this is largely fortuitous. It has been most unusual for a reserve to be established because of its entomological interest, and consequently most of the nation's finest butterfly sites are not nature reserves. There is an urgent need to rectify this. It is hoped that a major part of the funds raised will be spent on purchasing reserves, which will then be presented to conservation organisations. This will only be possible if large amounts, running to hundreds of thousands of pounds are raised, for land prices in the UK range from about £500 to £2,000 per acre.

b) Surveys

It is important that those species that are most in need of conservation are recognised, and that all their remaining sites are discovered so that the finest may be obtained as nature reserves. Huge advances have recently been made in the knowledge of the distribution and status of British butterflies through the national Biological Records Centre and local mapping schemes. However, those data are still far from comprehensive, and there has also been a need for intensive surveys of individual species. Seven species of butterfly have been surveyed to date, but information is needed on at least another six: *Hesperia comma, Papilio machaon, Nymphalis polychloros, Argynnis adippe, Apatura iris*, and *Erebia epiphron*. A typical survey at 1981 prices costs about £1,500. It is hoped that several more will be financed as a result of Butterfly Year.

c) Site Management

British conservationists have discovered that, having obtained a nature reserve, they have only taken the first step in the conservation of its butterflies (and much other wildlife). There is a depressingly long list of reserves that have lost colonies of (especially local) butterflies *after* they were declared. This has occurred because the precise ecological requirements of various species were not maintained on sites after purchase, either through mismanagement or, more usually, a lack of it. In fact it should be possible to manage current and future reserves to *improve* their habitats for butterflies rather than merely maintain them. This may again be expensive if, for example, it is necessary to fence and graze uneconomically an abandoned grassland site. To a lesser extent, parts of commercially used land may also be managed less economically for butterflies, but this may involve compensation to the owner.

d) Ecological Research

There is still a great ignorance about the exact habitat requirements of most butterflies that breed in the UK. There is an urgent need to rectify this, for otherwise there is a real risk that the efforts and expense of making surveys, buying sites, and then managing them will be wasted, simply because the wrong management measures are taken. Experience has shown that the precise ecological requirements of butterflies (especially local species) can rarely be guessed from a mere knowledge of it's life cycle, foodplant, and the rough 'look' of a site. There is little alternative to employing professional ecologists to make fulltime studies, although some short-cuts may now be possible with the commoner species and with improved techniques. Such research is expensive but vital. An example of the consequences of the failure to discover the exact needs of one butterfly (*Maculinea arion*) until after it was too late is given elsewhere in this issue.

There is, therefore, a need for large sums of money to be spent in the UK over the next decade if the declines of many of its butterflies are even partly to be stemmed. Only a selection of remedies has been outlined. It is hoped that the impetus given by Butterfly Year to an already growing general concern will be so great that the British public will eventually demand the conservation of its butterflies. And if it proves impossible to increase the national conservation 'cake', it is at least hoped that butterflies (and other insects) will be ensured a larger slice in the future.

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(Editor's Note: Several literature citations on pages 42 & 43 pertain to this subject.)

Conservation in the Amateur Entomologists' Society: Its Aims and Origins

David Lonsdale

54 Cherry Way, Alton, Hampshire GU34 2AX, England

I have never been sure whether there is a dividing line between a conservationist and a non-conservationist. Must one be a physically active conservationist to deserve the name, or is the assumption of a pro-conservation attitude a sufficient qualification? If the latter is true, then most of the 1600 members of the Amateur Entomologists' Society (AES) are conservationists. But perhaps something more than an attitude is required.

Even in terms of an active commitment to conservation, there have probably been conservationists within the AES since the Society began in 1935, but it wasn't until 1965 that a special group was formed. This was the AES Breeding Group and it was the brainchild of Ken Willmott whose main interest was in butterflies and who saw the release of bred specimens as a way in which we could reinforce waning butterfly populations. Already, however, there was some controversy about the usefulness of this practice and there were some suggestions that there could be genetic problems (e.g. inbreeding in the released insects and unfavourable genetic interaction between natural and artificially bred stock). Also, the AES Council felt that a conservation group should be mainly concerned with insect habitats. Thus in late 1967 the Group broadened its scope and became the 'Amateur Conservation Group' (later, the 'AES Conservation Group').

The extension of the Group's interest from butterfly breeding to general insect conservation soon highlighted the need for better co-operation amongst would-be conservationists and with outside organisations. In the enthusiastic hands of the Group's new Secretary, Bill Parker, the files began to fill with correspondence on local habitat problems and this emphasis on habitat was to shape the Group's aims as they exist today.

The wider range of activities confirmed a belief that there are no taxonomic boundaries in truly ecosystem-based conservation. Thus, for Bill Parker, the encouragement of interest in insect orders other than Lepidoptera was a major aim and, in 1968, the Group acquired a new section by absorbing a small Coleoptera conservation group which I had started a year earlier (almost by accident) within the British section of the Teen International Entomology Group (TIEG). Another merger around this time considerably enlarged the AES Group; this involved another TIEG group, the TIEG Conservation Group which was concerned with Lepidoptera and was founded by Nick Cook.

Developments in the Group's history since those days have been partly administrative, involving committee formation, fund raising and so on. But also we have gained experience from individual projects and from the exchange of opinions. We have formulated a policy which has just recently been adopted by the AES as a whole, and the Group as such no longer exists because conservation has now been given sufficient importance for the AES to assume direct responsibility. Perhaps by referring to some of the ideas and problems which interest us, I can convey something of what we are trying to achieve. (The express AES Conservation Policy appears at the end of this article.)

The Special Role of the Amateur Entomologist

Numerous cases have demonstrated that neither professionals involved in conservation nor non-entomological naturalists are likely always to be aware of insect habitat requirements except in a very restricted way. In both a general sense (i.e. what makes a site a good insect habitat?) and a specific sense (i.e. what special requirements does an individual species have in *all* the stages of its life cycle?) the amateur entomologist has special knowledge. Some of this may be intuitively based and hard to express in a factually impressive way but we are constantly trying to interest our members in co-operating with organisations which can act on their advice. This co-operation is aimed not only at the individual site project, but also at the improvement of awareness of our cause amongst other naturalists.

Changes in Land Use and the Role of Planning Authorities

Most British ecosystems are artificially controlled or semi-natural. Our major problem is thus not one of man destroying primal ecosystems; instead it is one of a greatly accelerated change in land use so that the diversity which has co-existed with man becomes lost and has little chance to develop anew. One of our most important local cases is an example of a change from one type of agriculture to another. The area is Ditchling Common, Sussex in southeast England and it has been a place where local people (Commoners) have exercised grazing rights and in which an interesting flora and fauna have developed. The localised butterfly Marsh Fritillary (*Euphydryas aurinia*) occurs there. In 1967 the then Chairman of the Commoners began burning and ploughing the Common and our member Peter Cribb (present Chairman of the Commoners) organised opposition to this while also initiating ecological studies of the site. Peter succeeded in his opposition on legal grounds and, in the years since then, he has continued to co-operate with local and national organisations to develop practices which will allow both worthwhile grazing and the regeneration of an interesting grassland ecosystem. This case must be seen in the wider context of the improvement of agriculturally marginal land which has become possible with the use of modern machinery and chemicals. Most high grade land in Britain has long been under intensive agricultural use so that, apart from field margins, hedgerows and other "oases" of wildlife, most ecologically interesting areas are on the agriculturally marginal land. Politically it seems to be expedient to encourage "improvement" of this land rather than to use the high grade land more

efficiently in producing food for humans. Incidentally, the Ditchling Common battle has flared up again.

Developments such as building and mineral extraction are subject to detailed planning procedures in Britain and there are sometimes consultations with conservation bodies. As far as local government officials are concerned, such consultations need be no more than an official letter to the recognised national or local conservation authority. But much depends on the knowledge and interests of the individuals concerned, and those interests often don't have much to do with insects.

An example concerns a registered Site of Special Scientific Interest called Brasside Ponds in northeast England. The registered status (which was based on the ornithological value of the site) necessitated consultation with the local naturalists' trust and a national body, the then Nature Conservancy. Since none of the individuals involved was aware of the considerable entomological interest, the plan to build a prison was nearly approved without comment. However our member Tom Dunn, who was on the local Trust's Council, but had missed a meeting, found out just in time and he soon attracted great interest in the site from naturalists and the mass media. He secured an agreement for the protection and management of the interesting areas by the local Trust. Again we see an example of an individual entomologist making a considerable impact, but this story has a sequel which I will shortly reveal.

Collecting and Conservation

The growing awareness of conservation in Western countries has often centered on hunting of mammals and birds, and this concern has extended to the collecting of insects. In some parts of the world there are now laws against collecting and these laws vary greatly in their specifications of protected types of insects. Within the AES there has been much controversy between pro- and anti-collectors, while those of us who are trying to organise conservation have listened to both sides. We have maintained an ecologically based approach which means that we oppose any practice which is likely to threaten the status of an insect population. Thus we are against the collection of very rare species or the over-collection of any species. 'Over-collection', apart from implying an obviously excessive number of specimens, means collecting more specimens than can be justified for the purposes of valid and worthwhile study. Offenders within the AES can be reprimanded or expelled from the Society. The AES also has given its support to a detailed Code for Insect Collectors which was produced several years ago by the Joint Committee for the Conservation of British Insects.

We do not frown on collecting *per se* since it is often essential in our own work when specimens have to be identified. We also see it as part of amateur entomology, especially from the point of view of the development of youthful interest. We see no excuse for the activities of unscrupulous collectors, but we do feel concern about the way in which they can divert attention from the problem of habitat destruction. This diversion of attention is becoming evident in the thinking of official bodies which want to demonstrate an interest in conservation.

Amenity and Conservation

If a person is trained to create neat grass lawns and if this grass is termed an 'amenity', and if amenity equals conservation, then we have problems. A few years ago we were in contact with a local government department which showed considerable interest in our suggestions for the conservation of some semi-natural sites in an urban 'wasteland' area. We felt that the wild character of the sites was a human amenity, apart from any wildlife interest. Meanwhile, another department of the same organisation was ploughing up the most interesting site and turning it into a single species grass sward. Co-ordination has improved since then, and in fact we have played our part in encouraging the development of a nature conservation plan for the whole area.

To return to our northeast England site, we find that Mr. Dunn's efforts were nearly thwarted five years later. Amenity and conservation became confused and he was confronted with a tree planting scheme (all in the interests of "conservation"). Fortunately he managed to save the nature reserve yet again by means of a compromise but we can see an illustration of the fact that entomology, as a minority interest, is often quite outside the thought processes of people who are trained in some restricted discipline such as urban amenity.

Human Bias in Conservation

As entomologists we are painfully aware that the criteria used to decide what should be conserved are often based on human bias. Concern about species and ecosystems alike often contains a strong bias toward that which can catch the public eye, regardless of ecological criteria. In Britain we have the Royal Society for the Protection of Birds which is a semi-official body and is able to buy large tracts of land for reserves. Such status is almost unimaginable for an insect conservation group. And yet we see something of value in the very impossibility of devoting large amounts of money and effort to our cause. This value lies in our necessity to build an awareness that things should be conserved on a broader basis than their esthetic appearance. We must co-exist with other species and such co-existence demands an ecological approach to conservation. We wouldn't claim that ornithologists are not aware of the ecosystems in which birds live, but if you happen not to have the resources to conserve what you happen to like, this ecological awareness is somehow heightened.

These sketches of our ideas and activities show perhaps most of all that our struggle is an uphill one. Perhaps our achievements can never become commensurate with the ecological and scientific importance of insects, but in hoping for such progress we are looking forward to the day when we have learnt to co-exist with the living things with which we share this planet.

AMATEUR ENTOMOLOGISTS' SOCIETY

Conservation Policy

The Society's policy towards conservation embodies the following aims.

1. To draw attention to the need for insects to be adequately considered in all wildlife conservation activities and to emphasise:
   a) the great ecological importance of insects
   b) man's dependence on insects, direct and indirect
   c) the beauty and scientific value of insects.
2. To help foster a climate of opinion in which ecological criteria rather than public popularity determine the place of insects in the allocation of resources for conservation.
3. To encourage and support the amateur entomologist in the recognition and conservation of valuable habitats.

4. To publicise the special habitat requirements of insects and to seek ways of lessening the damage caused through ignorance of these requirements.

The Society will work towards these aims in the following ways.

Conservation at Specific Sites

- Encouraging amateurs in survey and management work
- Co-operating with local conservation bodies, especially naturalists' trusts, in surveying and management
- Contacting individuals and organisations not primarily concerned with conservation but whose activities can affect interesting sites (e.g. local authorities and landowners)
- Organising field meetings at sites of interest

The Protection of Insects and Their Habitats from Unnecessary Destruction

- Supporting the use of the least harmful methods of pest control (e.g. avoiding the use of broad spectrum pesticides where 'non-target' species are at risk)
- Opposing the destruction of habitats through a desire for tidiness (as happens when dead wood is destroyed or wild areas in towns are grassed over)
- Discouraging the collection of rare insects or the collection of large numbers of other insects without good reason
- Attempting to ensure that any laws or other regulations which aim to conserve insects are based on ecological principles
- Encouraging the adequate consideration of insects in the selection of any sites for nature reserve status etc.
- Encouraging the protection and enhancement of insect habitats on land under everyday use (i.e. outside nature reserves)

Publications and Communication

- Liaising with other organisations as indicated above by consultation over specific sites and also by representation of our views in a general sense
- Helping to achieve the participation of major landowning organisations in ecologically based insect conservation
- Encouraging individual members to make the views of insect conservationists known to local societies and trusts
- Producing a special bulletin on insect conservation
- Producing other advisory information
- Encouraging co-operation between the amateur entomologist and the scientific research worker.

(Editor's note: Individuals may subscribe to the AES *Insect Conservation News* for one year by sending an International Money Order for three dollars to the author at the above address.)

Book Review

Butterfly Watching by Paul Whalley, Severn House, £7.95.

The first reaction to Paul Whalley's book is: "What a good idea! Why didn't someone think of it before?" Although, as the author says, the analogy between birdwatching and butterfly-watching must not be pushed too far, entomologists and other naturalists do have something to learn about observing and recording insects without catching them.

The book has seven chapters and six appendices, including one which summarises the life histories of "some European butterflies"— actually those which occur in Britain.

The first three chapters are orthodox ones on butterflies in human history, basic classification and biology, and how to identify and name the species observed. The text is lively and informative, and it is perhaps rather carping to wonder whether an initial plunge into watching one species in all its activities might not have been a more effective introduction. The fourth chapter on "Where to find butterflies" is a straightforward guide to butterfly habitats. Some criticisms may be semantic hairsplitting. The silver-studded blue, for instance, is said to occur on moorland, being classed with the large heath and Scotch argus; it is, in fact, particularly associated with southern heaths and has a different range and distribution from moorland butterflies. Nor can I agree that the Essex skipper is "primarily coastal". It is well distributed and often common inland, unlike the other two species correctly described as coastal.

The main part and message of the book comes in chapters five and six. "How to watch butterflies" is an excellent guide for the aspiring butterfly-watcher, with some good ideas on what to do and, more important, why to do it. Dr. Whalley explains how marking butterflies has contributed to scientific studies of migration and population ecology, but states that marking cannot be recommended to the amateur enthusiast. This is well-meant advice, but it may deter butterfly watchers from making useful and enjoyable studies. In "A closer look" the author gives sound information on how to catch butterflies for examination, on rearing and on butterflies in gardens. I particularly liked the balanced views on harmonising the control of pests and establishing a butterfly garden. Heather Angel has contributed a good, simple guide to butterfly photography in this section.

The last chapter, on butterfly conservation, is short but covers much ground. Emphasis is rightly given to education and in the section on collecting the author steers an admirable course between the twin evils of unrestrained over-collecting and fanatical opposition to collecting of any kinds. However, I am unconvinced of the possibility of the Apollo butterfly disappearing without the benefit of legal protection in (parts of) Europe; its zoogeographical range is enormous and the species can be in no danger, though no doubt some local populations may be at risk. More serious is the omission of any substantial treatment of management, both of butterfly populations and reserves, and the contributions which can be made in this field.

Butterfly Watching is well illustrated, with appropriate and unusual photographs of most of the British species. Richard Lewington's accurate and delicate drawings are a particular delight. It is interesting to note that there are many cases where the author's experience differs in detail from that of mine. Perhaps these discrepancies only emphasise the need for more, and more detailed, butterfly-watching. This should certainly be stimulated by this well-produced and attractively written book.

Reprint: Credit to *Natural World*, magazine of the Royal Society for Nature Conservation.

Reviewed by: M. G. Morris, Honorary secretary of the Joint Committee for the Conservation of British Insects

Invertebrate Conservation in the Nature Conservancy Council, Great Britain

Alan E. Stubbs

The Nature Conservancy Council, 19-20 Belgrave Square, London SW1X 8PY, England

Abstract

The Nature Conservancy Council (NCC) is a government-funded wildlife agency covering England, Scotland and Wales. Its main functions are to set up and manage reserves, and to give advice on conservation. In addition to its prime responsibility in Great Britain, it also has an involvement with international conservation.

Historical Background

The organisation began as the Nature Conservancy in 1949 and after various changes, including separation from its research stations (which now belong to the Institute of Terrestrial Ecology (ITE)), became the NCC in 1973. There has thus been over 30 years of experience as a government agency though it is fair to say that throughout this period the resources have not been adequate for an increasingly demanding and urgent task.

A number of active entomologists in the old Nature Conservancy were involved in research teams on particular habitats and several worked on rare species, although they had neither the time nor specific remit for national invertebrate conservation. With the reorganisation in 1973, the research entomologists found themselves in a new body called the ITE. The new NCC set up a Chief Scientist's Team to commission research and to develop the conservation policy on specialist fields. Thus in 1975 I joined the Chief Scientist's Team as terrestrial invertebrate zoologist. In 1979 Ian McLean joined the Team to give support on the terrestrial side and Margaret Palmer became the Team's specialist on freshwater invertebrates. Also in 1979 David Sheppard joined the newly created England Field Survey Unit. Additionally, a number of regional staff are active entomologists.

There is no denying that over the last 30 years there have been many missed opportunities and examples of inaction because of inadequate attention being placed on the need for invertebrate conservation. These difficulties in the earlier days of conservation must be seen in the complex historical and resources context in which they arose, but important lessons have been learnt. The NCC is working to place the approach to invertebrate conservation on a much firmer footing and to develop a detailed policy for the field of invertebrate conservation. However, government resources for all aspects of nature conservation are likely to remain sparse whilst Britain's economic difficulties continue unresolved.

The Nature Conservancy Council's Commissioned Research Programme

When the research stations became the basis of the ITE, the NCC was allocated funds to contract research. Much of this research has been carried out by former Nature Conservancy colleagues in ITE.

Most of the Biological Records Centre (BRC) work is highly relevant to conservation. Thus a contract covers the management of British recording schemes including atlas production. The concern about decline of butterflies, even on some National Nature Reserves (NNRs), led to NCC contracting the refinement of transect recording methodology and its deployment on reserves as a means of monitoring butterfly populations—our wardens are generally the field recorders and ITE process the data and analyse for trends. It is interesting to note that an obvious management problem has been identified on only one reserve and here another (non ITE) contract survey had already been set up because of the known seriousness of the situation. Much of the main phase of research on the autecology of the Large Blue (*Maculinea arion*) was funded by NCC under contract to ITE because it was recognised that this type of work can be essential in order to devise the correct management procedures for critical species. The Phytophagous Insect Data Bank, once operational, will enable more efficient decisions on survey and management.

Other contracts with ITE have concerned habitat survey. A survey of coastal sandy sites in Scotland was undertaken in the face of North Sea oil developments which were leading to major site problems in a part of Britain where there was little scientific information available. A survey of mature timber habitats helped refine our knowledge of the sites and fauna of importance in association with dead wood and ancient trees. Combining survey with a broader conservation issue, the work on fragmentation of heathlands in Dorset will be of considerable interest since so often NCC staff are having to argue their case with planners that large blocks of habitat are necessary for conservation and that the progressive fragmentation and reduction of sites causes a loss of species. The end result of the heathland work is of course unknown, but it should illuminate the degree of severity of this conservation problem.

All the above commissioned research has been under contracts placed with ITE but various other contracts have been placed with individuals and universities. These have mostly been small contracts, but a major study by Dr. Coulson at Durham University looked into the geographic variation in invertebrate faunas of moorland in northern England as a basis for assessing the strategy for habitat repesentation on conservation sites.

It is worth concluding this section by saying that one of the strengths of British conservation is that there is a wealth of research expertise, particularly in ITE, on invertebrate conservation problems. However, much of this sort of research is expensive, the overriding weakness being that the research budget of NCC is small relative to its needs.

Invertebrate Conservation Review

A Nature Conservation Review was carried out and has been published after an evolution over ten years or so. This defines the most important sites in Britain, but mainly with regard to an ecological representation of habitats assessed in botanical and ornithological criteria. There was only a partial and very incomplete consideration of invertebrates.

It is clear that invertebrate conservation cannot be considered on a proper basis until the important entomological sites in Britain have been properly identified. Moreover, the management needs of invertebrates on reserves and other sites cannot be taken into account until the invertebrate interest is documented. There is increasing urgency in this matter since habitat is being lost at such a rate that the options for site conservation are diminishing fast. The management measures taken on the sites that remain must be properly reviewed if the loss of critical invertebrate species is to be avoided.

Thus, after 30 years, and one false start in 1978 when a financial axe came down, NCC is at last to put major emphasis on identifying which sites are of conservation importance for invertebrates. Four people are employed on two year contracts working with NCC (including one specialist on butterflies and one on moths). They are setting up an Invertebrate Site Register which will be based on the views of entomologists (and other invertebrate zoologists) on the location of important sites. It is highly unlikely that such a project can be completed in two years, but at least a start will have been made.

Most other needs relate to such a register and to the broader goals of the Nature Conservation Review (Ratcliffe, 1977). All 167 NNRs require documentation and a review of management policies. All Nature Conservation Review sites (over 800, including the NNRs) require assessment, noting that these sites are the basis for selecting future reserves (in principle all these sites are of reserve standard but there is not enough money among conservation agencies and organisations to make all into reserves). The Invertebrate Site Register is bound to highlight the existence of important sites where no conservation action has previously been considered and on such sites, as well as on existing scheduled sites (sites notified to planning authorities as Sites of Special Scientific Interest), the factual scientific case for conservation must be clearly spelled out if NCC is to argue its case for conservation in the face of competing land use changes. The Biological Recording Schemes have a strong complementary relationship, as does the Insect Red Data Book which is under development (by a committee on which NCC is represented). Also related is the need for a workable bibliography to the British literature; key word indexed information has been extracted from the main British journals since 1930 and it is hoped that this will be functioning on computer within the next 12 months. Clearly access to published site data is important. Survey methodology, the work of NCC field survey units, the Phytophagous Insect Data Bank and monitoring of butterflies on NNRs all relate to an overall Invertebrate Conservation Review.

NCC has recently reviewed the conservation needs of certain invertebrate groups and booklets have been published for bees and wasps, dragonflies, and snails, slugs and freshwater mussels (Else, *et al.*, 1978; Chelmick, *et al.*, 1980; Kerney and Stubbs, 1980). All major invertebrate groups are being reviewed in this fashion, leading to habitat reviews on the lines of that already published on dead wood (Stubbs, 1972). These all form part of an Invertebrate Conservation Review strategy. One of the outcomes of this programme should be a much closer involvement of entomologists in conservation; they hold the basic knowledge and their interests can only be taken into account if they see that there is a genuine opportunity for their views to be heard.

A Few General Comments

Britain stands in a relatively experienced position in conservation both as regards its official and voluntary conservation bodies. Since this journal is read by an international audience, there is one message which is particularly important—the need for invertebrate conservation is urgent and it will not look after itself incidental to the protection of habitats for other wildlife. We have lost important sites, and species, because action has been too late (a theme not unique to insects). Even on the broad conservation front Britain has never been at such a precarious point as now in the face of very rapid destruction of habitat. One can ride for so long on a reduction in habitat, but in Britain we are near the point of losing the best remaining examples of certain habitat types. The position is aggrevated since habitat destruction by agriculture and forestry is heavily subsidised by the government as economic 'improvement' while conservation has totally inadequate resources compared to the scale of these and other land use changes. Most conservation sites are in private hands and we are losing 4-5 percent per year (i.e. completely destroyed or severely damaged) of our Sites of Special Scientific Interest; compounded over a few years, the outlook is catastrophic. Most NNRs are on lease from private owners and many of these leases are coming up for renewal in an economic climate where renewal may be resisted.

Experience in Britain has shown that firm protection requires that a site be acquired by a conservation body. This is not an easy option when money is so scarce relative to rising land values. But even if that difficulty can be overcome, necessary management too can be expensive. Inadequate management has resulted in the deterioration of the invertebrate fauna on some reserves.

Conclusion

This discussion has obviously been selective and many important items have had to be omitted. It is hoped, however, that this and other papers from Britain will give encouragement and show that there is determination to get invertebrate conservation onto a firm footing. In the final analysis the solution calls for entomologists and others to treat conservation as a priority and to assist conservation bodies to safeguard invertebrate faunas. The urgency of the situation requires action and determination and that will be true in all countries. Despite the difficulties, a great deal has been done and can yet be achieved in conservation of invertebrate diversity. Britain's NCC will continue to play a special role in this effort.

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International Red Data Book of Invertebrates

Robert Michael Pyle

Species Conservation Monitoring Unit of IUCN, 219c Huntingdon Road, Cambridge CB3 0DL, England[2]

In a recent paper on international insect conservation (Pyle, 1978(1981)), I voiced the need for Red Data Books (RDB) of Lepidoptera and other invertebrates. Many national RDB efforts are underway (see, for example, J. Heath in this issue regarding the British RDB), but it was felt that IUCN should initiate an Invertebrata counterpart to its successful international Red Data Book volumes covering all the classes of Vertebrata. I can now report that this has been done, and that the Invertebrate Red Data Book is well underway.

In 1980, I was contracted by IUCN (the International Union for Conservation of Nature and Natural Resources) to undertake a pilot study for an Invertebrate Red Data Book (IRDB). At the same time, the Species Conservation Monitoring Unit (SCMU)[1] was established in Cambridge, England, as a base of operations for all of the RDBs, which had formerly been produced in Switzerland and elsewhere. A fully professional RDB effort was launched, replacing the largely volunteer project of the past. Susan Wells was hired as Co-compiler of the IRDB, concentrating on mollusks and other non-Arthropods, while I emphasized insects and their allies. The work was continued in 1981, and my involvement will carry into 1982.

Obviously, an IRDB cannot be approached in the same manner as vertebrate RDBs. It would be absurd to suggest that the whole of Invertebrata might be surveyed, species by species, after the fashion of mammals or birds. However, such an undertaking is not out of the question for butterflies, eventually, nor for other well known and popular groups. I concluded in the original study that a different kind of goal, yet no less valuable, would be appropriate for the great majority of non-vertebrate animals. That is, by searching for and investigating examples of threatened invertebrate species or faunas, we can do much to illustrate the array of these organisms being affected by human pressures, as well as what those pressures are and what might be their outcome.

Consequently, we are seeking paradigms of threatened invertebrates from as many phyla as possible, from Protozoa to Chordata. Wherever information permits, will will prepare RDB "sheets" or reports on these taxa in the traditional Red Data Book format, with some innovations to suit invertebrate characteristics. The kinds of information sought include names, description, distribution, habitat and ecology, scientific interest and potential value, threats to survival, conservation measures taken and proposed, and references. From the available data we will designate taxa as Endangered, Vulnerable or Rare, of Indeterminate status, or Insufficiently Known. Since invertebrates often fail to fit systems developed for vertebrates, we are innovating with new categories such as Threatened Fauna or Threatened Habitat (containing more than one taxon subject to the same threat), Threatened as a Spectacle or Phenomenon (e.g., Mexican Monarch roosts), and Threatened as an Economic Resource. An information sheet is available explaining both the categories and the contents.

Initial outputs of the IRDB project will appear in three stages. First, some thirty illustrated leaflets will be published by autumn of 1981, for distribution at the IUCN General Assembly in Christchurch, New Zealand. These will test the idea and publicize the program. Initial sheets will range from Mexican Monarch butterfly roosts and New Guinea birdwings to Medicinal Leeches, giant earthworms, Pacific Island snails, an owlet midge, a *Stentor* protozoan, and New Zealand beetles, Wetas and habitats. Second, Volume One of the IRDB containing many more species will be published as a hardback book in 1982. Third, specialist volumes will be produced; the earliest of these are likely to treat Papilionidae (swallowtails) of the world (with M. G. Morris's cooperation), Sphingidae (hawkmoths) and land and freshwater mollusks. Subsequent work will probably consist of a continuation of the general survey, additional butterfly and moth RDBs and detailed treatments of other invertebrate groups as information becomes available. Periodic reports relating to IRDB tasks may also be published; two of these (Wells, 1981a, 1981b) have already been produced, in conjunction with IUCN's Wildlife Trade Monitoring Unit. The purpose of the RDBs is to make available current, reliable information on diminishing diversity, for conservation purposes. They have often served as powerful political and scientific tools in the conservation of species and habitats.

Our job is immense, and some would call it hubristic. Yet along with some skepticism, we have received a great deal of enthusiastic aid from invertebrate biologists and conservationists all over the world. We actively solicit suggestions for species to be included, as well as references, contacts and criticisms. Contributors may review drafts prior to publication, and will be acknowledged. An international Red Data Book for Invertebrates is now a reality; its quality and impact will depend upon the degree of cooperation we receive. Further reports will appear in future numbers of *Atala*.

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[1]Now a part of the Conservation Monitoring Centre.

[2]Permanent address: Swede Park, Loop Rd. Box 123, Gray's River, WA 98621, USA

The Butterflies of Bernwood Forest, England

Caroline Peachey

The Nature Conservancy Council, 19-20 Belgrave Square, London SW1X 8PY, England

In the years 1975-1980 a total of 42 butterfly species was recorded in Bernwood Forest, a large woodland complex on the Oxfordshire/Buckinghamshire border, making it one of the richest butterfly localities in Britain.

Throughout this century Bernwood has been well known for its richness of Lepidoptera, although the Forest is quite a different place from what it was 50 years ago. Originally oak woodland, the Forest was traditionally managed as coppice-with-standards; however, this type of management declined at the beginning of this century and after a series of fellings during the Second World War, the Forest consisted of poor oak coppice with large areas of grassland and scrub which provided a variety of habitats for butterflies.

In 1952 the Forest passed into the hands of the Forestry Commission and today much of the woodland has been replanted with conifers or conifers and oak. There was naturally great concern among entomologists when the change of ownership occurred. The policy of felling hardwoods would mean that the native vegetation would be reduced and as a result, the variety of Lepidoptera would diminish. Consequently in 1955 an agreement was reached between the Forestry Commission and Nature Conservancy whereby 60 hectares of woodland in the northern part of Waterperry Wood was raised to the status of Forest Nature Reserve. Ten glades were cut to encourage and maintain the butterfly fauna and coppicing was resumed in a small area to the north of the wood. Also, in the Shabbington woods, blackthorn (*Prunus spinosa* L.) clumps were protected and managed by the local Naturalists' Trust for the black hairstreak (*Strymonidia pruni* L.), a rare woodland butterfly in Britain.

In 1976 Dr. Denis Owen (pers. comm.) of Oxford Polytechnic discovered that there were fewer butterfly species in the Forest Nature Reserve than in the nearby Shabbington woods, fewer than 30 as against 39. This discovery revealed the surprising fact that the butterflies appeared to be surviving in the woods in spite of changing management practices. However, were the butterflies only just surviving as marginal populations, or were they thriving under the present conditions? This question prompted Dr. Owen to carry out a detailed ecological survey of the butterflies and 1978 saw the start of the research, in which I was fortunate to be able to assist.

To assess the micro-distribution and abundance of the butterflies and elucidate the subtleties of habitat selection, a transect recording technique was used. This technique was first developed by Moore (1975) and later adapted for use in woodland rides by Pollard (1977). A route was chosen to include a representative sample of habitat types. The route was walked at a uniform pace and all butterflies within five metres were recorded. In order to provide a degree of standardization, counts were started after 10.45 h. B.S.T. and completed before 15.45 h., and only in suitable weather conditions.

A transect count was made each week and an annual index of abundance for each species was obtained. The counts gave a good indication of the relative abundance of the species and the timing of their broods. In addition to recording the presence of an individual, aspects of its behaviour and location were also noted. Many of the local species (e.g. the dingy skipper (*Erynnis tages* L.), Duke of Burgundy fritillary (*Hamearis lucina* L.)) are confined to only two or three rides along the transect. Further experimental studies revealed that they have special habitat requirements and therefore are restricted to certain habitat types.

The common species are mostly grass feeders, which is not surprising since the rides are grassy. However, each grass-feeding species has a distinct habitat preference. Among the Satyridae, the speckled wood (*Pararge aegeria* L.) prefers shady rides; the small heath (*Coenonympha pamphilus* L.) and marbled white (*Melanargia galathea* L.) dry, open rides, and the ringlet (*Aphantopus hyperantus* L.) damper rides with wide, shrubby edges.

Nectar resource utilization was studied in detail and adult feeding was observed on 55 species of flowering plant. Some plants were preferable to others and had a significant effect on the distribution of a few butterfly species. Bramble (*Rubus* spp.) and thistles (*Cirsium* spp.) were great favourites and attracted many species of butterflies, in particular large numbers of meadow browns (*Maniola jurtina* L.) and the white admiral (*Ladogo camilla* L.). The greatest number of butterflies was in fact found in the rides with the highest diversity of plant species. Such rides are wide with a tall herb zone and shrubby edges (Figure 1). Nevertheless, many of the narrow rides are dominated by tall, coarse grasses and are too shady for most species of butterflies.

The existence of a good ride system within the plantations of Bernwood Forest is a major reason for the continuing survival of the butterflies. As well as providing a good foraging habitat they are also used by over 20 species for breeding.The age class distribution of the trees is another important factor. Although over 50% of the Forest consists of middle-aged plantations (20-25 years old), there is a young plantation containing 6-9 year old conifers, which provides an ideal habitat for the butterflies requiring a more open habitat. The fritillaries are particularly abundant in this area and their larvae feed on violets (e. g. *Viola riviniana* Reichb.) which grow profusely between the conifers. Of course the area will only be suitable for a relatively short time. As the conifers grow increased shading will eventually exclude the short herb flora and its associated fauna. A similar situation occurred in the past when the woods were regularly coppiced; however, unlike the long forestry cycles today, the coppice cycles (approx. 13 years) produced a patchwork of areas in different stages of regeneration. Consequently the fritillaries and other species were able to recolonise other suitable areas.

Figure 1. The main ride in the Shabbington Woods. Note that one side has been cut. The cutting of rides is carried out by the Forestry Commission in late summer and is proving to be beneficial for maintaining the ride flora.

There is little doubt that one of the main reasons for the lower number of species in the Forest Nature Reserve is the lack of suitable rides and other open habitats. The glades and the coppice plots have not on the whole been very successful in maintaining the butterfly populations, mainly because of problems with management (lack of labour), deer browsing, and the small size of these habitats. The reserve only accounts for 13% of the whole Forest. The woods comprising Bernwood are over 480 hectares in extent and form one of the largest blocks of woodland in the area. It is likely the viability of the Forest and the range of niches within a large block of habitat which account for the present high species diversity.

The smaller woods around Bernwood could be important in their reciprocal roles as colonisation pools. During the fellings in Bernwood local extinctions probably took place. However, there were alternative reservoirs in the surrounding woods to repopulate the area when conditions were again favourable. The purple emperor (*Apatura iris* L.) for instance is generally only found in well wooded districts and may be breeding in a number of nearby woods. The butterflies are strong fliers and if one particular wood is felled or becomes too overgrown, the females are known to fly up to 9 kilometres to find another suitable wood to recolonise. In the Bernwood area the existence of three neighbouring woods (Figure 2) containing suitable purple emperor habitat has probably played an important part in maintaining populations in the past and should continue to do so in the future. However, already two of the woods are under threat from a proposed motorway extension.

Finally, the existence of a good forest edge habitat, including a few surrounding unimproved meadows, has also been a factor in limiting the number of extinctions which might have taken place. Many butterflies are ecotonal species, requiring the particular light and shelter conditions that a hedge or woodland edge will provide. A number of important larval food plants are located in the hedges, and they often provide a good nectar foraging habitat as well. It is probable that after a felling many of the species requiring shelter contracted to these edges and existed as marginal populations until conditions were again suitable for recolonisation.

Will the present management policy be adequate for the continuing survival of the butterflies? The species have survived over the past 100 years because, quite simply, active management has provided the continuity of open conditions required by the butterflies and their foodplants. Breeding areas have obviously been periodically destroyed, but this process has been staggered in time and the rate at which new areas were regenerated and colonised must have been fast enough to allow the butterflies to survive. However, Bernwood has reached the stage of minimal change; no more planting is to be carried out by the Forestry Commission and, apart from general maintenance, the woods are being left until the first crop is ready to fell—which may not be for another 40 years. Many of the narrow rides will almost certainly become unsuitable as butterfly habitats and consequently the wider rides will become even more important for maintaining the butterfly populations. Yet unless widened, these rides will receive increasing shade annually as the flanking shrubs and trees grow taller. The decline of the wood white (*Leptidea sinapsis* L.) in several of its localities has been attributed to rides becoming overgrown.

If no more felling were to take place until the first crop is ready to fell, there will inevitably be a decline in the fritillaries and other species which require a more open habitat. In ten years' time the largest open area—the young plantation—will no longer be suitable; and unless a nearby area is opened up in the near future, some of these species may well become extinct in Bernwood Forest. The species confined to the woodland edge and neighbouring meadows are also being threatened with the increasing pressures on these habitats, e.g. removal of hedges, improved drainage, scrub clearance, reclamation of marginal land and improvement of pastures.

It would be a disaster if the butterfly fauna of Bernwood Forest was allowed to decline and dwindle into insignificance.

"If the butterflies could be encouraged by a substantial programme of suitable management we would be preserving something of great ecological and aesthetic value, and

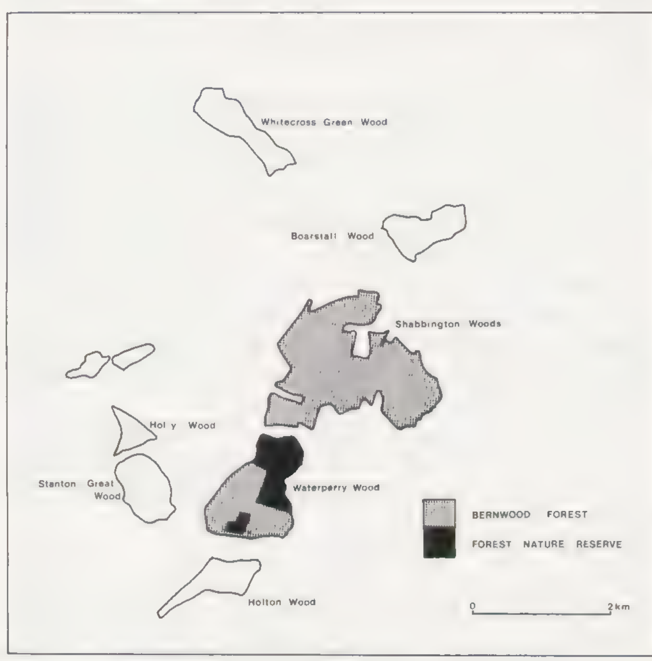

Figure 2. Bernwood Forest and the neighbouring woods.

developing a resource which is likely to become an increasingly important part of our natural heritage."
(R. Hornby, pers. comm.)

Fortunately the Forestry Commission is increasingly recognising the value of their plantations for wildlife. Discussions are now going ahead between the Nature Conservancy Council and the Forestry Commission on the future of Bernwood Forest. The best means of securing the future of the entomological interest probably lies with the two bodies entering into a long-term agreement, which sets out the necessary management principles and proposals. The continuity of open habitats is perhaps the most important proposal and it will be necessary to prescribe a minimum area of cleared ground or young plantation.

The national policy of increasing timber production has led to the Forestry Commission owning three million acres. In addition, other forestry organisations and private land owners are adopting modern forestry techniques, including the conversion of semi-natural habitats to conifer plantations. Thus it is important that there is a reconciliation between the needs of forestry and conservation.

The knowledge that Bernwood owes its diversity of butterflies to the past continuity of open habitats, provides the key to their future safeguard. The opportunity exists to write detailed conservation principles into long-term forestry plans. Imaginative agreement could protect an impressive array of butterflies for the benefit of future generations. It could also help in developing an understanding between academics, conservationists and foresters and bring credit to them all.

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ANNOUNCEMENTS & NOTICES

The Biology of Butterflies

A 4-day symposium organised by the Royal Entomological Society of London is being held on 23-26 September 1981 at South Kensington, London. The symposium concerns population biology, emphasising ecological, genetical and physiological themes, with sixteen review lectures supplemented by discussion papers, exhibits and films. Accommodation and entertainments will be available within the vicinity. Invited lectures are to be given by Robin Baker, Michael Boppre', Paul Brakefield, Lincoln Brower, Frances Chew, Kit Cottrell, Jack Dempster, Paul Ehrlich, Larry Gilbert, Charles Remington, Arthur Shapiro, Bob Silberglied, Michael Singer, David Smith, Jeremy Thomas and John Turner. Convenors: R. I. Vane-Wright and P. R. Ackery, British Museum (Natural History), London SW7 5BD. You may obtain further information and registration forms from The Registrar, Royal Entomological Society of London, 41 Queen's Gate, London SW7 5HU, England, Telephone 01-584 8361.

SOCIETAS EUROPAEA LEPIDOPTEROLOGICA

THIRD EUROPEAN CONGRESS OF LEPIDOPTEROLOGY
CAMBRIDGE, ENGLAND -- 13-16 APRIL, 1982

The Third European Congress of Lepidopterology will be held in Churchill College, Cambridge, 13-16 April, 1982.

The main theme of this congress will be:

Lepidoptera Ecology and Biogeography

with

Conservation of the Lepidoptera

as a subsidiary theme.

Provisional offers on these and other Lepidopterological topics should be sent as soon as possible to:

John Heath
Monks Wood Experimental Station
Abbots Ripton
Huntingdon
Cambridgeshire
PE17 2LS
ENGLAND

Further details of the Congress will be issued in due course to those showing interest.

The Conservation of Odonata in Great Britain

N. W. Moore

The Nature Conservancy Council, 19-20 Belgrave Square, London SW1X 8PY, England

Abstract

Recent unprecedented changes in agricultural practices have caused the loss of numerous aquatic habitats throughout the British lowlands. On the other hand, water supply schemes and increased gravel and clay extraction have produced many new water bodies. The effects of these activities on the British odonate fauna are discussed. Since 1950, *Coenagrion scitulum* **(Ramb.),** *C. armatum* **(Charp.) and** *Oxygastra curtisi* **(Dale) have almost certainly become extinct. Populations of** *Lestes dryas* **Kirby,** *Aeshna isosceles* **(Muell.) and** *Sympetrum sanguineum* **(Muell.) have become much reduced; the first two are now very rare insects.** *Orthetrum cancellatum* **(L.) and** *Aeshna mixta* **Latr. appear to be increasing. National Nature Reserves in Britain are selected as representatives of habitat types rather than to protect particular species, nevertheless 32 out of the 41 species breeding regularly in 1950 now occur in these reserves. Three other species are protected in reserves managed by voluntary conservation bodies and 2 others in the state-owned New Forest. The scheduling of the Hampshire locality of** *O. curtisi* **as a "Site of Special Scientific Interest" failed to prevent its extinction through the pollution of its habitat. The value of several nature reserves for dragonflies has been increased by making new ponds. Populations of local species such as** *Leucorrhinia dubia* **(Vander L.), and** *S. sanguineum* **have been increased, and** *Coenagrion mercuriale* **(Charp.) was encouraged to colonise a reserve where it was previously absent by these means. The Nature Conservancy Council is undertaking experiments with the aim of reintroducing species into the Fens which have become extinct there in recent years.**

Introduction

Great Britain has an impoverished odonate fauna. In 1950 it consisted of 44 species, of which three, *Sympetrum vulgatum* (L.), *S. flaveolum* (L.) and *S. fonscolombei* (Selys) were only occasional immigrants and did not maintain regular breeding populations in the country (Corbet *et al.*, 1960). Nevertheless active steps are being taken to conserve the fauna for scientific and aesthetic reasons.

In this paper changes in land use which affect odonate habitat are described, together with effects which these appear to be having on dragonflies; and finally conservation measures are outlined.

Land Use Changes

The last quarter of a century has witnessed changes in British agriculture, which are more fundamental than any which have occurred before. Greatly increased agricultural productivity has been achieved by the use of artificial fertilisers and pesticides, by improvements in land drainage, by new cultural techniques and by plant and animal breeding. Parallel to these developments industrialisation has increased throughout the country; new towns and motorways have been built. The building programmes have required vast quantities of chalk, clay and gravel, which have been dug in many parts of lowland England; many of the pits have filled with water. New reservoirs have been made. Thus old odonate habitats have been destroyed and new ones created. No comprehensive studies have been made on the changes in odonate habitat, but several detailed studies give some indication of the scale of the changes.

Reclamation schemes and improved drainage have greatly reduced the number of marshes and bogs containing permanent water. For example, the bogs and ponds of the heathlands of Dorset support a rich dragonfly fauna (Moore, 1964) including *Ceriagrion tenellum* (Vill.), *Coenagrion mercuriale* (Charp.) and *Ischnura pumilio* (Charp.). The total area of heathland was reduced from 18,000 ha in 1934 to 10,000 ha in 1960 and to 6,000 in 1975 (Moore, 1962; Bibby & Tubbs, 1975). The marshlands of East Sussex which supported good populations of *Lestes dryas* Kirby in 1940 had declined by at least 40% by 1974 (unpublished data).

The change-over from mixed farming to purely arable farming in much of eastern England and the provision of piped water for farm animals has caused a great reduction in farm ponds. For example Relton (1972) records a 35% loss of ponds in Kimbolton parish Huntingdonshire between 1950 and 1969, and Jones (1971) a loss of 26% of 1402 ponds studied in NE Leicestershire between 1930 and 1970. Twenty-eight new towns are in various stages of development in England, Wales and Scotland, and 1770 km of new motorway have been built in England and Wales since 1945, mostly on lowland country. Many ponds and watercourses have been made unsuitable for Odonata as the result of pollution with industrial and agricultural chemicals. Others have lost all their dragonflies except for a few very resilient species such as *Ischnura elegans* (Vander L.). Herbi-

This article was originally published in *Odonatologica* (1976) 5(1): 37-44, and is reprinted herein in its entirety.

cides such as dalapon, diquat and dichlobenil are used increasingly instead of mechanical means to keep drainage ditches free of water plants. The loss of waterlilies (*Nuphar* and *Nymphaea*) due to herbicides results in the loss of *Erythromma najas* (Hans). On the other hand numerous new waterbodies have been created as the result of gravel and clay extraction. Of 730 pits in 1954 40% were flooded. At that time about 360 ha were excavated each year, but about half this area was filled in (Atkinson-Willes, 1963). Gravel pits are particularly suitable for *Orthetrum cancellatum* (L.) and *Enallagma cyathigerum* (Charp.). In addition there are over 500 reservoirs in England and Wales covering an area of over 15,000 ha (Atkinson-Willes, 1961). Some are unsuitable for Odonata.

The Effects of the Land Use Changes on the Odonata Fauna

The following statements are based on the author's largely unpublished observations made from 1939 onwards and from discussions with other odonatists with experience over the same length of time. During the 25 years since 1950 it appears that Britain has lost three species:

(1) *Coenagrion scitulum* (Ramb.) due to the inundation of its one locality in Essex by the North Sea floods in 1953.
(2) *Coenagrion armatum* (Charp.) due to the lowering of the water table and hence alteration of its habitat in the Norfolk Broads. A thorough but unsuccessful attempt to discover the species was made by a group of odonatists in 1975.
(3) *Oxygastra curtisi* (Dale) due to pollution in the West Moors River caused by the installation of a sewage works upstream of the dragonfly's locality. It has not been seen there for several years. This species has occasionally been recorded from Devonshire where suitable habitat appears to exist. A survey of all six principal rivers there was made by the author in 1975 under ideal weather conditions, but the insect was not observed.

In addition three species have shown notable declines.

(1) *Lestes dryas* Kirby no longer occurs in many of the Fenland and Romney Marsh/East Sussex localities where it was found thirty years ago. This is due to the disappearance of suitable marshes caused by lowering of the water tables.
(2) *Aeshna isosceles* (Muell.) which became extinct in the Fens in the nineteenth century, appears to have declined in the Broads district of Norfolk. Many other organisms have also declined in this district; the reasons appear to be lowering the water table and eutrophication of the broads and rivers.
(3) *Sympetrum sanguineum* (Muell.) is notably less common in the Fens and Romney Marsh than it was thirty years ago, doubtless due to the disappearance of suitable habitat caused by lowering the water table. The extensive use of herbicides to control waterweed may have been a contributory cause.

On the other hand *Orthetrum cancellatum* appears to be more abundant. In some areas this must be due to the great increase in gravel pits and reservoirs which provide very suitable habitats for this species. They are also extensively colonised by common species such as *Enallagma cyathigerum*, and in the south by *Anax imperator* Leach. *Aeshna mixta* Latr., which was called The Scarce *Aeshna* by Miss Cynthia Longfield in the thirties (Longfield, 1937), is now much the commonest *Aeshna* in much of southeast England, though what proportion breed in this country is not known. There is no obvious reason for the increase in this species. Doubtless the habitat changes mentioned in this paper have affected the abundance of many other species, but the effects are not obvious.

Thanks to the Insect Distribution maps scheme organised by the Biological Records Centre at Monks Wood Experimental Station much is being learnt about the past and present distribution of British Odonata. Soon the maps will be accurate enough to alert conservation entomologists to major changes in the status of all Odonata species. The preliminary map of the distribution of *Ceriagrion tenellum* is shown in Figure 1. Though not complete it gives a clear indication of the recent decline of the species in the eastern part of its range.

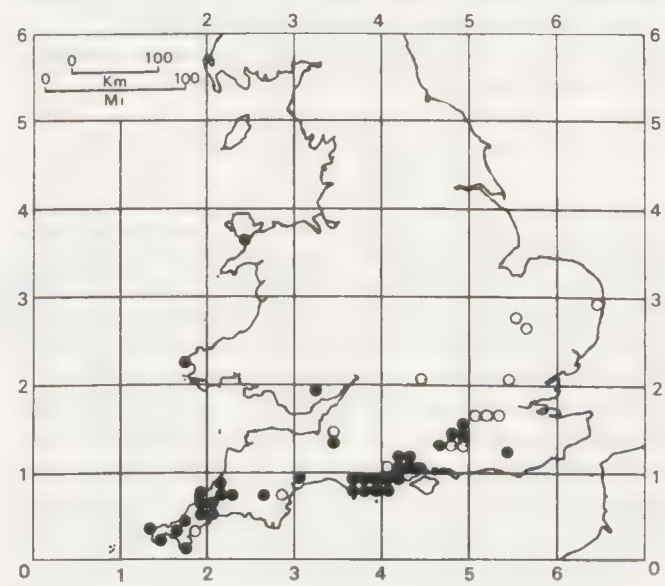

Figure 1. The distribution of *Ceriagrion tenellum* (Vill.) in Great Britain. Circles include records up to and including 1960. Dots denote subsequent records (Skelton, 1974).

Conservation of Odonata in Nature Reserves

Official conservation in Great Britain is the responsibility of the Nature Conservancy Council, which operates by establishing, maintaining and managing National Nature Reserves (NNRs) (in 1975 there were 140 totalling c. 121,000 ha) and by giving advice about conservation matters to both government and non-governmental departments and organisations. The NNRs are reinforced by local nature reserves maintained by local authorities and by numerous nature reserves belonging to or managed by voluntary conservation organisations, notably the County Naturalist Trusts, the Royal Society for the Protection of Birds and the National Trust.

No reserve has been set up specifically to conserve Odonata. The NNR system is intended to represent all the main habitat types found in Britain. It is interesting to discover the extent to which this method of selecting reserves has been successful in conserving Odonata. At present no fewer than 32 species of the 41 species which were breeding regularly in Britain in 1950

occur in NNRs. In addition two other species are protected in the New Forest in Hampshire, which is Crown land and where the Nature Conservancy Council advises the Forestry Commission on wildlife management. Another three species are protected in nature reserves run by County Naturalist Trusts. Only four species (*Coenagrion scitulum, C. hastulatum* (Charp.), *Oxygastra curtisi* and *Somatochlora metallica* (Vander L.) have received no protection on nature reserves. This suggests that a system of reserve selection based on protecting a wide range of habitats has been effective in conserving the majority of British dragonfly species.

S. metallica and *O. curtisi* were given some protection by scheduling their habitats as "Sites of Special Scientific Interest" (S.S.S.I.). Thus the Planning Officers concerned were informed about the sites and had to consult the Nature Conservancy Council when development was proposed on them. The S.S.S.I. procedure has saved some sites, but owing to the narrow legal definition of "development", which does not include drainage, it is an inadequate safeguard. As stated above, it did not prevent the pollution of the West Moors river and hence the extinction of *O. curtisi* in its only certain British locality.

Conservation of Odonata by Management in Nature Reserves

Nature reserves provide refuges, whose conservation value increases as habitats outside them become less suitable for dragonflies. More should be established; however existing reserves can be made much more suitable for dragonflies for a very small cost. Some progress has been made already. In 1961 the author arranged for 20 circular ponds, each of 7 m in diameter, to be created in Woodwalton Fen National Nature Reserve in Huntingdonshire. First a careful survey of the area was undertaken to make sure that nothing of biological interest would be destroyed by the operation. Information was obtained about the water table to ensure that the ponds would hold permanent water. Then the ponds were dug out by a power operated dragline. The total cost was £70. Since that date the imagines of 15 species of Odonata have been observed by the ponds and 11 species have bred in them including *Brachytron pratense* (Muell.) and *Sympetrum sanguineum*, which are becoming rare in the country surrounding the nature reserve. (A full account of the colonisation of the ponds is being prepared for publication). The Hartland Moor National Nature Reserve in Dorset supports good populations of most of the British acidophilic Odonata, but *Coenagrion mercuriale*, which occurs in three localities nearby, was absent. By enlarging a small stream to form a pond the warden of the reserve, Mr. M. V. Tuck, made a habitat suitable for *C. mercuriale* which soon colonised the reserve.

The Surrey Naturalists' Trust manages a heathland nature reserve in their county which supports an isolated population of *Leucorrhinia dubia* (Vander L.). There was some danger of the bogs on the reserve drying out and so they asked the Army to blow a large hole in the middle of one of the bogs with high explosive. *L. dubia* has colonised the new pond which resulted, and so the chance of survival of *L. dubia* on the reserve has been greatly increased. Incidentally, this species, which is very local in Britain, is also protected on one Scottish and one English National Nature Reserve.

Originally the Fens contained a few acid waterbodies and some dragonfly species dependent on them. For example *Ceriagrion tenellum, Sympetrum danae* (Sulz.) and *Orthetrum coerulescens* (Fabr.) all occurred at Wicken Fen, now a National Trust reserve. These acid waters depended for their existence on peat cutting and disappeared about 50 years ago when peat digging was no longer practised; the acidophilic dragonflies disappeared with them. Attempts are now being made to recreate acid water ponds in two fenland NNRs and carefully controlled experiments are being conducted to determine whether it is feasible to introduce the lost fenland species. Previous experimental work (Moore, 1964) showed how easy it is to transfer imaginal Zygoptera from one pond to another; so introductions should not be too difficult. A more serious problem is posed by the necessarily small area of the new waterbodies. However, despite territorial behaviour which produces very low population densities of reproductive males (Moore, 1964), very restricted isolated habitats have been known to support populations of Odonata for many years. For example there was probably never room for more than 100 territories of *O. curtisi* in the West Moors locality (often much less), and that population survived for at least 140 years.

Some biologists may doubt the propriety of providing man-made habitats for dragonflies. However it must be remembered that the vast majority of ponds and lakes already inhabited by dragonflies in lowland England today are man-made. The only difference is that they were not created for dragonflies, while those described above were made on purpose for them.

Species confined to flowing water cannot be conserved by digging ponds. Fortunately upland rivers and streams, and hence the habitat of species such as *Cordulegaster boltoni* (Don.), are valuable for water supply and salmon and trout fishing and so generally receive good protection from pollution. Species such as *Libellula fulva* Muell. which are virtually confined to slow moving rivers are much more difficult to conserve, since their habitat is easily polluted and the forces working against its pollution are less powerful. However, *L. fulva* is holding its own in England, and since pollution is being gradually reduced in British rivers, thanks to the efforts of the Water Authorities, its survival and that of other species with similar requirements should be assured.

Conclusions

Habitat is being destroyed or damaged on such a scale in Great Britain that the survival of the odonate fauna cannot be taken for granted. Therefore conservation by means of nature reserves is becoming increasingly important. Much progress has been made already but the value of many nature reserves could be further enchanced by creating new habitats on them. Pilot studies are most encouraging in this respect. More rigorous pollution control is essential for the protection of species confined to rivers.

Finally the effectiveness of conservation measures depends upon research. There is an urgent need to learn more about the exact requirements of threatened species, and more must be learnt about the minimal areas of habitat necessary to protect viable populations.

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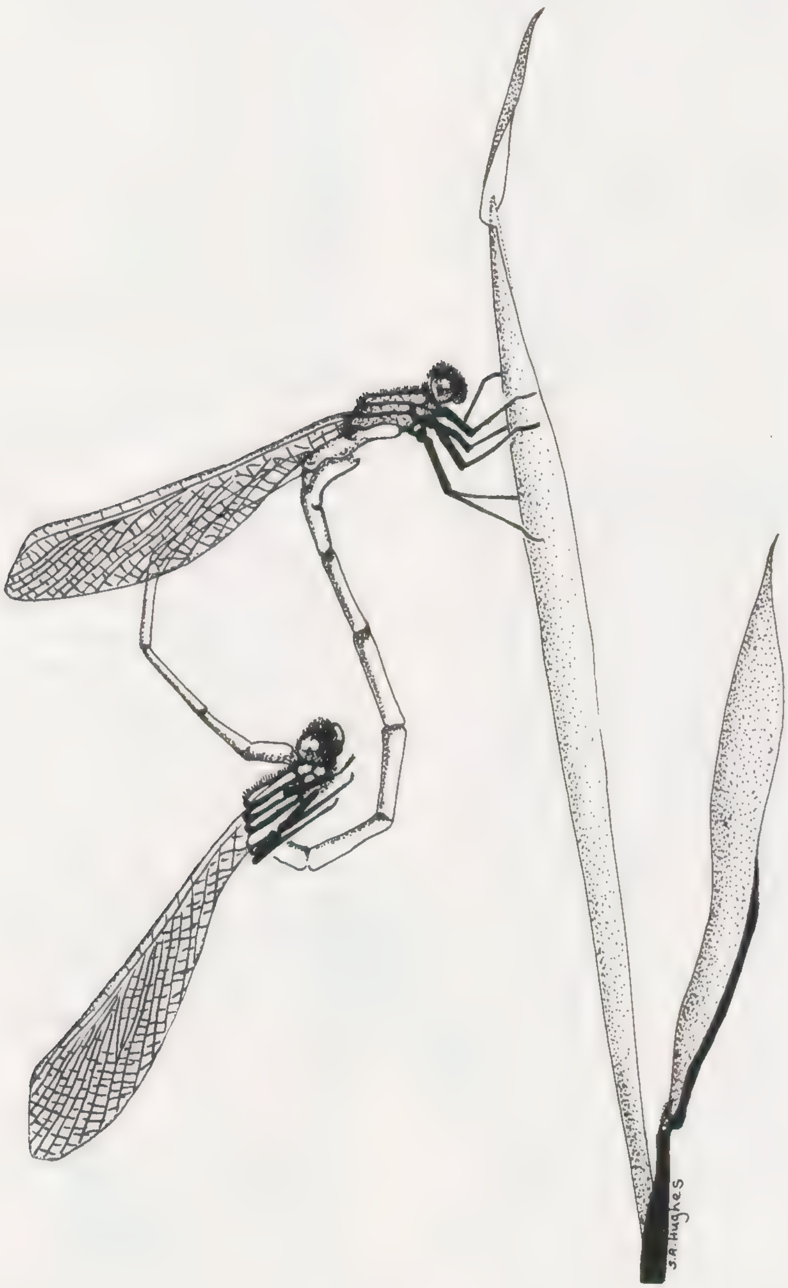
(Editor's Note: See also "The Conservation of Dragonflies," page 71.)



Monitoring Changes in Butterfly Numbers

E. Pollard

Institute of Terrestrial Ecology, Natural Environment Research Council, Monks Wood Experimental Station, Abbots Ripton, Huntingdon, Cambridgeshire PE17 2LS, England

Many naturalists whose memories go back thirty years or more, consider that there are now far fewer butterflies than there used to be. They may well be correct but we have no solid evidence, only memories, and these are notoriously unreliable and cannot be quantified. Only when species have gone entirely, or have newly colonised an area, can we be sure that a change has occurred.

At times, as in the 1960s when organochlorine pesticides were under close scrutiny, there have been heated debates about the possible decline in butterfly numbers and its causes. In the absence of evidence however such debates could only be inconclusive. Also over the last thirty years many National Nature Reserves (NNRs) have been established in Britain by the Nature Conservancy Council for the conservation of wildlife. A few were established specifically for the protection of rare butterflies. Initially, however, there was no monitoring of changes in abundance and so no measure of the success or failure of reserve management. This is also true of many local nature reserves established during the same period.

For these reasons, and for others, a group of entomologists at Monks Wood Experimental Station started making simple transect counts of butterflies in Monks Wood's NNR (near Huntingdon, Cambridgeshire). We selected a route through the wood and made frequent counts, through the summer months, of all butterflies seen within a specified distance from the walking recorder. The results were encouraging, as differences between recorders and the effects of weather on counts, above the minimum conditions we adopted, were not too large.

We were sufficiently encouraged to write up and publish the results of this first year (Pollard, *et al.*, 1975) and to extend recording to a number of sites in the east of England. Several of the recorders were wardens of nature reserves and we were particularly keen to see whether they could fit in regular weekly counts with their other duties. Again the results were encouraging, and after two years of these pilot trials, a national scheme was begun in 1976 (Pollard, 1979).

The national scheme for monitoring the abundance of butterflies is financed by the Nature Conservancy Council and coordinated at Monks Wood by the Institute of Terrestrial Ecology. Many of the recorders are wardens of NNRs but there are also commercial forestry sites, farmland, and one urban area in the scheme. The terrain varies enormously from exposed mountains in Scotland to sheltered conifer plantations, and from arable farmland to the wetlands of the Norfolk Broads.

At each of the 80 sites in the scheme the recorder chooses a route which he/she considers to be representative of the habitats in the area. The route is divided into sections for recording purposes, to provide information on the distribution of butterflies along the route. The weekly counts for each brood are to give an index of abundance for each species, and this is used to show changes in relative abundance from year to year (Pollard, 1977). An example, that of the large white (*Pieris brassicae* L.), is shown in Figure 1. We believe this species suffered badly from a severe drought in 1976.

The enthusiasm of the recorders and the quality of recording has been good. An average transect is about 2 miles (3 km) long and takes one to one-and-a-half hours to complete. One such transect a week does not seem much of a commitment but in practice, given the unpredictability of the British climate, it requires that the recorder must be available for much of the week to take advantage of a few hours of sunshine or warm weather. It is preferable that one recorder should make all the counts at a site, but it is sensible to train a substitute for annual holidays and emergencies.

The recorders send their results to Monks Wood at the end of each season. We check the recording forms, and, with computer aid, calculate the indices of abundance. We collate the data from all of the sites, to show regional and national trends and then write an annual report, specifically for the recorders, to help them to put their own data in a wider context. We are completely dependent on the recorders for the success of the scheme and feel that it is essential to do everything we can to retain their interest and enthusiasm. Our aim is to maintain continuity of recording at sites.

Monitoring itself, that is the aquisition of data on population fluctuations and longer-term trends, is valuable for highlighting areas in which detailed research studies are required. However it is the interpretation of the recorded changes which is of most interest and value. Several years' data are required before we can begin to show correlations between regional fluctuations in butterfly numbers and climatic fluctuations, and also, at a local level, the effect of habitat changes. In the next few years we hope to concentrate on this aspect of the scheme. One limitation to interpretation is our lack of knowledge of the ecology of most of our butterfly species, even some of the most common and familiar ones. In the Institute of Terrestrial Ecology the combination of mapping schemes and monitoring provides a solid platform for the detailed population studies necessary for the conservation of butterflies. However, it must be emphasised that we are only making a beginning in the acquisition of the knowledge required for successful conservation.

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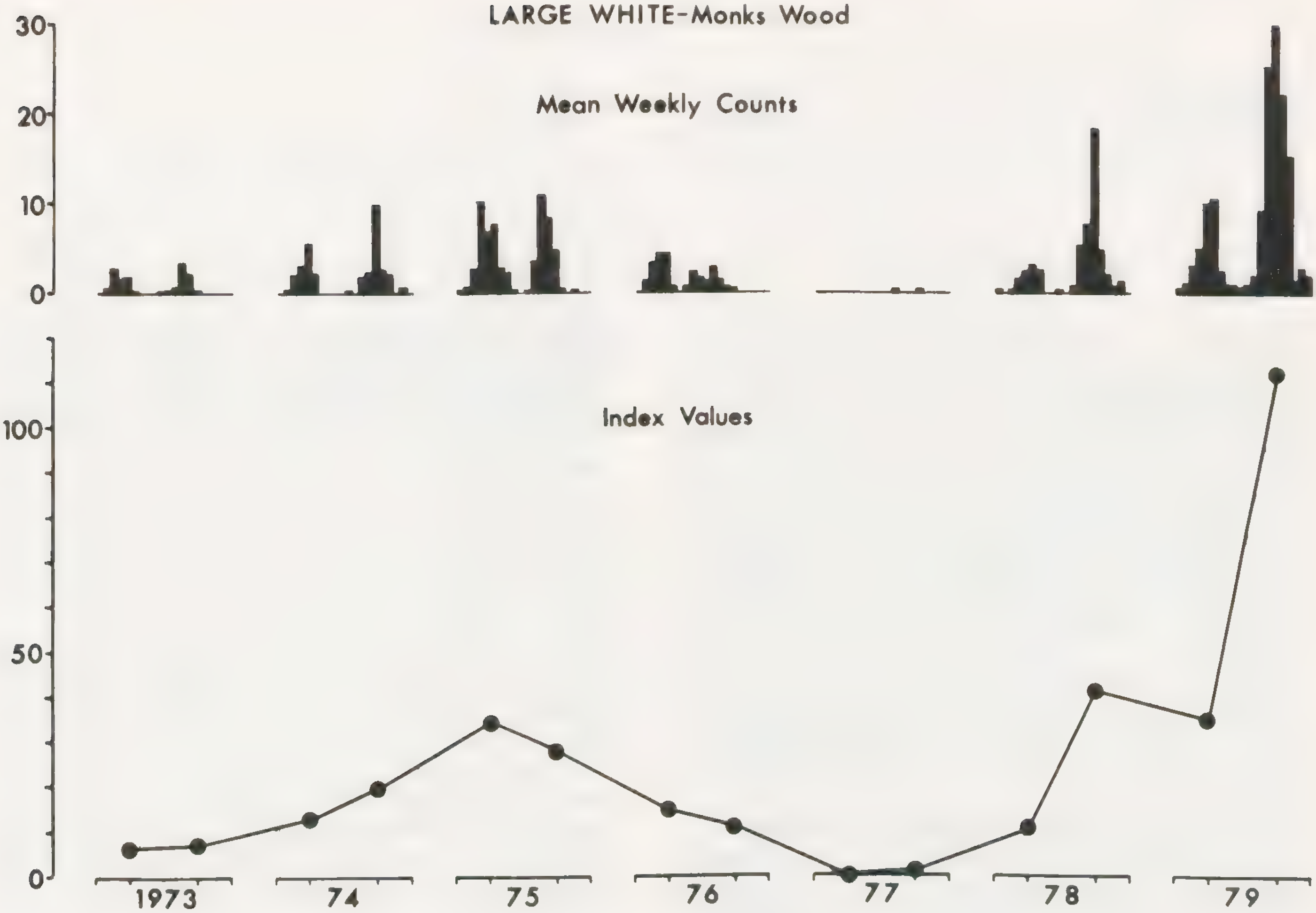


Figure 1. Mean weekly counts with index of abundance values of the Large White (*Pieris brassicae* L.) at Monks Wood Experimental Station.

Large White (*Pieris brassicae*)

LETTER

Dear Sir,

I am writing to draw attention to a fragile freshwater habitat threatened by motor boats.

In England, many large slow rivers and canals have predominantly silty bottoms. They are characterised by narrow marginal marshes of emergent vegetation and fringes of trees with extensive submerged root systems. The vegetation forms an important habitat which supports a great diversity of species. The submerged parts offer a firm substratum, clear of clogging fine sediment, to epiphytic organisms, and to the many species which feed on these or on the plants themselves. They also provide an essential hiding place for invertebrates and young fish.

In the past, canals and large rivers formed a major transport network, originally by slow horse-drawn barges which caused little wash. Today, these same waters are used by large numbers of powered pleasure launches with greater and more erosive washes.

The marginal vegetation is disappearing. For example, a 1920's map of the middle reaches of the River Thames shows a small marsh at the outer edge of each bend. Today, the few marshes which still exist are much reduced. Apparently there was a thriving raffia basketwork industry based on the marginal marshes of the River Thames, at one time. It died out in large part because the broad-leaved reeds at the margins disappeared. Boat wash removes silt under the plant roots and in many places the marsh edge can be rolled back for a foot or more. The plants soon become completely detached, eventually exposing the bank itself to attack. A common solution to bank erosion is sheet piling but this supports a very limited fauna and is unsightly.

Even where the vegetation survives, the plants and animals associated with it are affected by wave wash. Caddis-flies (Trichoptera), my own particular interest, illustrate this. Larvae of fourteen species were found among submerged willow tree roots (*Salix* spp.) in an unnavigated tributary of the Thames, but a hundred yards away, in the main River Thames, only half that number could be found. The roots there had a polished appearance compared with those in the tributary.

The caddis-fly *Leptocerus lusitanicus* (McLachlan) (Leptoceridae) is only known in Britain from the middle reaches of the River Thames. In the 1940's adults abounded, but today the species is restricted to a few quiet backwaters where its larvae live among *Salix* roots. It will presumably disappear completely if these are developed for boating. Similarly, the larva of *Notidobia ciliaris* (L.) (Sericostomatidae) is found among the roots of grasses and sedge in canals and is under threat in at least two very popular waters.

Coarse anglers of the River Dee in Cheshire recently complained that fish stocks had dropped and blamed the powerboats. Support for their allegation comes from a comparison of fifty-year-old photographs with the river's appearance today. This indicates that marginal marsh was much more widespread. (The photographs also show water-lilies (*Nuphar*) in flower, but today propellors cut back all but completely submerged leaves). Two schemes to provide cover and substrata for young fish and invertebrates are proposed by Liverpool University's Fisheries Department. Piles of large stones or stones enclosed in coarse mesh baskets may be sunk at intervals. In addition, areas of the remaining marsh may be protected. Boats were excluded from a small area as an experiment last year and water-lilies were seen on that section of the Dee for the first time in ten years.

It is to be hoped that the importance of marginal marshes is appreciated and that protective measures are undertaken before most of our large rivers and canals are reduced to mere steel-lined gullies.

Sincerely,

Ian A. Wallace
Merseyside County Museums
William Brown Street,
Liverpool L3 8EN England

Abstracts of Recent Literature

Dempster, J. P. & M. L. Hall, 1980. An attempt at re-establishing the swallowtail butterfly at Wicken Fen. Ecological Entomology (1980) 5, 327-334.

Details of a reintroduction of the swallowtail, *Papilio machaon*, to Wicken Fen are given. The introduced population expanded at first, but crashed as a result of the 1976 drought. It then failed to recover and is probably now again extinct on the Fen. The changes in the habitat and the status of the butterfly's food plant, *Peucedanum palustre*, caused by the drying out of the Fen are discussed, and it is concluded that there is no chance of re-establishing the butterfly permanently at Wicken, unless the Fen can be made wetter.

Warren, M. S. Unpubl. Ph.D. dissertation, Cambridge University, 1981. The ecology of the Wood White butterfly, *Leptidea sinapis*.

The project was an investigation of the autecology of *Leptidea sinapis* in two woodland populations at Yardley Chase, Northamptonshire. The aims were to examine its population dynamics and habitat requirements, with the intention of providing recommendations for its conservation.

Preliminary sections describe the distribution and life-history of *L. sinapis*. It is now a very locally distributed species in Britain and more than half its colonies inhabit rides and clearings in commercial forestry plantations. Previous life table studies on butterflies are reviewed and their contribution to pest control and nature conservation is discussed.

Life table analysis showed that yearly changes in the size of two *L. sinapis* populations were caused by several "key" factors. In the largest population (about 3,600 adults in 1978) the annual fluctuations between 1977 and 1980 were caused by mortalities in the egg and hatching stages and reductions in fecundity. The latter was considered to be related to the temperature during the oviposition period. In the other population annual fluctuations were thought to be caused by pupal mortality and immigration following habitat changes.

The distribution of adults within these colonies was examined in relation to the light climate of woodland rides (assessed by hemispherical photography) and to the distribution of certain resources. The results indicated that adult density and larval food plant abundance were both related to the light climate of the rides. The most suitable conditions for *L. sinapis* were considered to be partially shaded rides where food plants and nectar-sources were abundant.

The results of the life table analysis and the habitat study are combined in a discussion of the short- and long-term trends in the size of woodland populations. Long-term trends are considered to be caused mainly by changes in the light climate of the breeding habitats, although short-term yearly fluctuations may be determined by a variety of other factors amongst which weather may be important. A tentative explanation of the decline of *L. sinapis* towards the end of the 19th century is that many woodland habitats became too shaded following the abandonment of traditional forms of management. Finally, recommendations are made about the conservation of *L. sinapis*, with special reference to the light climate and management of woodland rides.

Available Publications on Insect Conservation in Great Britain

From the Institute of Terrestrial Ecology

BUTTERFLY RESEARCH IN I.T.E.

by Marney L. Hall, I.T.E., Monks Wood Experimental Station 28 pp., 22 color plates, 14 figures. £2 (or dollar equivalent), postpaid.

Published in June 1981, this is a very valuable summary of the many keystone studies in butterfly ecology, behavior and conservation management conducted by scientists of I.T.E. (formerly the Nature Conservancy). The contents include: Introduction, The Biological Records Centre, The Butterfly Monitoring Scheme, The Porton Down Survey, the black hairstreak butterfly, the brown hairstreak butterfly, the white admiral butterfly, the swallowtail butterfly, the large blue butterfly, the wood white butterfly, the pearl-bordered fritillary, and Conclusion. Marney Hall, longtime employee at Monks Wood Experimental Station and co-author with Jack Dempster of papers on the swallowtail, has written this review in an interpretive style to communicate the often complex data in a manner palatable for a wide audience. This is a landmark publication and an extremely good bargain at its low price, particularly taking into account the large amount of color. Highly recommended.

Order from Publications Department, I.T.E., 68 Hills Road, Cambridge, CB2 1LA, England.

From the Nature Conservancy Council

THE CONSERVATION OF BEES AND WASPS

by George Else, John Felton and Alan Stubbs

THE CONSERVATION OF DRAGONFLIES

by David Chelmick, Cyril Hammond, Norman Moore and Alan Stubbs

THE CONSERVATION OF SNAILS, SLUGS AND FRESH WATER MUSSELS

by Michael Kerney and Alan Stubbs

These very attractive booklets, illustrated with color covers and many halftones, are authoritatively yet engagingly written. They cover their subjects in Britain very fully, and in principal are very applicable elsewhere. All three may be obtained for £1.50, postpaid, from the Interpretative Branch, N.C.C., Attingham Park, Shrewsbury, SY4 4TW, England.

PLEASE NOTE: INTERNATIONAL MONEY ORDERS ARE THE BEST WAY TO PAY FOR THESE PUBLICATIONS.

Editor's Note and Postscript to the British Issue

The articles and notes in this number of *Atala* have nearly spanned the array of insect conservation problems and activities in Great Britain today. There is, however, much more.

We have not, for example, dealt with Scotland, Wales, or Nortern Ireland in any detail. Yet in Northern Ireland exists one of the finest butterfly enhancement-cum-insect education areas anywhere, the Drum Manor Butterfly Garden. In Wales, near the coast at Aberystwyth, lies Borth Bog: a National Nature Reserve which is the last remaining habitat of the Rosy Marsh Moth (*Coenophila subrosea*) in Britain. Scotland, much less populated than England, has less pressing problems in butterfly conservation, according to G. Thompson in his excellent new book *The Butterflies of Scotland: A Natural History* (Croom Helm Ltd.). Yet, Scotland faces massive coniferization of the moorlands, and drainage and peat-removal threaten such moorland butterflies as the Large Heath (*Coenonympha tullia*). And the full responsibility for conserving British Chequered Skippers (*Carterocephalus palaemon*) now falls to the Scots, as this butterfly has become extinct in England along with the Large Blue. So the issue does stretch throughout the Kingdom, even if wild Cornwall is considered a separate "state," as Cornishmen are wont to do: for here survive some of the last colonies of England's threatened Heath Fritillary (*Melitaea athalia*). As proprietor of the Duchy of Cornwall, Prince Charles, it is hoped, will take a personal interest in managing Duchy lands to protect this special Cornish resource.

Merely by glancing at the papers, one can appreciate the richness of activity in our special sphere of interest in Britain. In recent weeks, the Sunday newspapers and color supplements alone have carried articles on the British swallowtail and its life history; Butterfly Year and the new butterfly stamps; in-flight photos of butterflies by Nicholas Brown; the Great Raft Spider, Britain's largest and rarest, and efforts to conserve it (including a sponsored walk on its behalf); an appreciation of slugs; and two pieces on mollusk conservation, pertaining to protection of the edible snail or Escargot (*Helix pomatia*) and a program of captive breeding for Pacific Island tree snails of the genus *Partula*, being wiped out in nature by an introduced American predaceous snail. Then there were frequent letters to the editor about insect conservation, and the issue of the popular *Radio Times* highlighting butterflies, referred to in Jeremy Thomas's article on Butterfly Year. One simply cannot fail to hear about the subject.

There is even going to be an extramural course on "The Conservation of Butterflies" in June, run by the University of Bristol and taught by John F. Burton, Robert Goodden, Paul Whalley and Denis Owen. Two Britons, Michael G. Morris (XS member) and Susan M. Wells, have received Winston Churchill Fellowships this year, both for the study of threatened invertebrates. Dr. Morris will examine butterfly farming in Papua New Guinea, Sri Lanka and elsewhere, and Ms. Wells will investigate trade and habitat threats to Pacific Island mollusks.

Perhaps most evocative of this trend to me was a scene in a village post office the day the new butterfly stamps were issued. A line (or "queue") of people awaited service, and as each customer went past it he or she studied a poster all about butterfly conservation. This vignette was no different from what would happen in thousands of post offices all over the United Kingdom, throughout the period the stamps are on sale. Millions of people will be exposed to the need for countryside conservation, if butterflies are to remain common. The irony has not been missed by many, that two of the butterflies selected for the stamps long ago, the Large Blue and the Chequered Skipper, have since gone extinct in England.

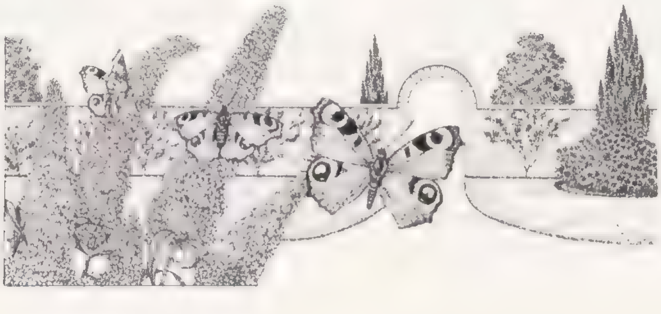
And yet, with all this outpouring of enthusiasm, the butterflies and other wildlife are not safe. Agriculture is ever-intensifying. At this writing, the Wildlife and Countryside Bill is struggling through Parliament, so weakened and diluted by crippling amendments that conservationists doubt whether it has any worth—or teeth—left. As I stated at the Slimbridge ceremony for the launch of Butterfly Year and the issue of the stamps, Great Britain is the very cradle of butterfly conservation: what happens here influences us all. The movement may indeed be stronger here than anywhere else, but the opposition is far stronger, and far richer. So, if any Xerces Society members wish to join the Battle for British Butterflies during Butterfly Year, they are welcome and warmly encouraged to do so. Contributions may be sent to:

BBCS BUTTERFLY YEAR FUND, (N)
The British Butterfly Conservation Society
Tudor House, Quorn, Leicestershire
LE 12 8 AD ENGLAND

OR

Butterfly Appeal
World Wildlife Fund (UK)
Panda House
29 Greville Street
London EC1N 8AX ENGLAND

Please make checks payable to BBCS or WWF and label them for BUTTERFLIES. Requests for more information about Butterfly Year and the British Butterfly Conservation Society may also be addressed to BBCS, a sister organization of the Xerces Society. WINGS will report on the progress of Butterfly Year. If it works in Britain, perhaps it would work in the colonies. The editor welcomes any reactions to this first "theme" issue of *Atala*.



EDITORIAL STAFF OF *ATALA*

SUGGESTIONS FOR CONTRIBUTORS

Formal scientific articles and notes dealing with any aspect of the ecology and conservation of endangered or threatened terrestrial arthropods are solicited. Articles will generally be longer papers, notes not exceeding 1000 words. Reviews of books dealing with terrestrial arthropod conservation or endangered habitats are also invited. Appropriate philosophical papers will be welcomed for use in the "Commentary" section.

All manuscripts should be typewritten on white, 8½ x 11 inch, good quality bond paper, on one side only, double- or triple-spaced throughout, with margins of at least one inch on all sides. The original typescript and at least one (preferably two) xeroxed or carbon copies should be submitted; authors should also retain a copy of manuscripts and figures for later consultation with the editors.

Please include illustrations if appropriate. Figures should be consecutively numbered in Arabic numerals. Hand-drawn figures should be rendered in black ink on good quality white paper. They may be larger than final reproduced size. Black and white glossy photographs may also be submitted. These and artwork will be returned after publication if accompanied by return postage. Figure captions should be typed, double-spaced, on a separate sheet, and the number of the figure lightly pencilled on the back of each drawing or photograph. A sketch map should be included as a figure with all articles or notes dealing in a major way with a specific region or arthropod habitat.

Cover art changes with each issue, and contributions will be gratefully received. Cover illustrations should generally show insects or other arthropods in *living* poses, and prospective cover artists should consult with the Editor before submitting material.

Tables should be numbered consecutively in Arabic numerals and submitted in photo-ready condition on separate sheets. Please include full scientific name, *with authors*, for both plants and animals mentioned in any manuscript submitted for publication in *Atala*. The metric measurement system should be used, with English system equivalents in parentheses if desired. Full references to literature cited should appear in a separate section at the end of articles or commentary papers, but should be parenthetically incorporated within the text of notes. Please include an *informative abstract* of approximately 150 to 250 words with all articles. Avoid footnotes to text statements if possible; such information can usually be included within the text. Words to be set in *italics* should be underlined. Reprints of articles are available at cost. An author will receive a reprint order form after acceptance of a manuscript. The style of *Atala* generally follows that recommended in the *CBE Style Manual* (1972). Abbreviations of journal titles follow *Bibliographic Guide for Editors and Authors* (1974).

Prospective authors may request a copy of the detailed editorial policy of *Atala* from the Editor.

COVER

The cover drawing portrays the English Large Copper (*Lycaena dispar*). The English subspecies (*L. d. dispar*) became extinct in the mid-nineteenth century due primarily to draining of the great East Anglian Fens. Fragments of its marshland habitat have been saved and rehabilitated in nature reserves, and one of these, Woodwalton Fen National Nature Reserve, supports an introduced colony of Large Coppers. The introduction, made originally more than half a century ago, comprised Dutch stock (*L. d. batava*). The species still requires intensive management in order to survive, but the goal is still held of a free-living population in time. Early indications suggest that the "new" British stock resembles the extinct British Large Copper in several quantified characters more closely than it does the Dutch ancestor subspecies. More of the story of the Large Copper is told in the first paper of this issue.

The cover artist is once again Sarah Anne Hughes, who has previously drawn *Atala* covers depicting Schaus Swallowtail, and endangered underwing moth and the periodical cicada. Sarah is a printmaker working primarily in botanical etchings. Her home and studio are in Gray's River, Washington.

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1979

BUTTERFLY COUNT RESULTS

J. A. POWELL & J. T. SORENSON, editors

SUPPLEMENT TO ATALA
volume 7 (1979) August 1980

THE XERCES SOCIETY

FOURTH OF JULY BUTTERFLY COUNT 1979 RESULTS

Edited by J. A. Powell and J. T. Sorensen

The 1979 Fourth of July Butterfly Count was designated for 23 June to 15 July, although a few participants at higher Rocky Mountain sites selected later dates, extending to 1 August. There were 43 counts reported, involving 281 participants and representing 20 states, including Hawaii, and one Canadian province, Manitoba. Colorado, with 10 counts, and Connecticut with 6, were best represented. All of these totals are higher than any previous year since the annual counts began in 1975.

Numbers of species ranged from 3 (UCLA) to 65 (Ramsey Canyon, Arizona) and 66 (Gilpin Co., Colorado, lower circle). Numbers of participants ranged from one (6 counts) to 36 (Pool Wildlife Sanctuary, Pennsylvania) and 37 (Eagle Summit, Alaska), and averaged 6.5 observers per center. About one-half of the counts were conducted at new centers. While it is encouraging to see new participation, it is to be hoped that these represent areas with high potential for continuance on a year to year basis. A total of 45 counts are reported, including the 1978 Kentucky counts, results of which were not received by the count coordinator in 1978. About 14 reports originate from Refuges, Sanctuaries, National Parks and University campuses, and therefore are sites that are likely to remain available to repeated counts by resident naturalists.

ZONE I: SOUTHWEST
(Arizona, California)

Berkeley, CA 37°52'N, 122°15'W, center UC Berkeley, includes: see 1975-77 reports for description. 23 June 1979; 0915-1540. Clear, hazy. 16-30°C, wind negligible. Fourteen observers in 5 parties. Total party-hours 28.07 (22.4 on foot, 5.67 by car); total party-miles 115 (19 on foot, 96 by car). Observers: M.E. Buegler, J.A. DeBenedictis, G. Frankie, R. Garrison, J. Garrison, R.L. Langston, S. Meredith, L.J. Orsak, D.J. Powell, J.A. Powell (Dept. of Entomology, Wellman Hall, Univ. Calif., Berkeley, CA 94720), E.M. Randal, K. Smith, J.T. Sorensen, K.H. Sorensen. Conservation status: See 1975-77 reports. Changes since last year: Total individuals/party hour on foot increased substantially, to 71.9 (up from 60.5 in 1978), the fifth consecutive year this average has increased, posing an interesting question of relationship to size of parties and efficiency through elimination of less productive sites. Battus philenor 31(S), Papilio zelicaon 15(C,S), P. eurymedon 21(S), P. rutulus 25(S), Pieris rapae 154(N,S), P. napi 2(S), Euchloe ausonides 10(C,S), Anthocharis sara 1(C), Colias eurytheme 15(S), C. eurydice 1(S), Strymon melinus 19(C,S), S. dryope 9(C,N), Habrodais grunus 27(C,S), Lycaena xanthoides 47(C,S), L. gorgon 20(C,S), Plebeius acmon 146(N,S), Euphilotes enoptes 20(C,S), Celastrina argiolus 66(N,S), Coenonympha tullia 73(S), Cercyonis pegala 49(C,S), Agraulis vanillae 7 (S), Adelpha bredowi 19(S), Limenitis lorquini 9(S), Vanessa atalanta 10(S), V. virginiensis 14(C,S), V. cardui 24(C,S), V. annabella 12(S), Junonia coenia 235 (S), Polygonia satyrus 20(C,S), P. oreas 3(C), Nymphalis antiopa 9(S), Phyciodes mylitta 78(S), P. campestris 5(N,S), Euphydryas chalcedona 190(S), Speyeria coronis 2(C), S. callippe 1(C), Danaus plexippus 3(S), Paratrytone melane 70(S,C), Ochlodes agricola 74(S,C,), O. sylvanoides 1(C), Hylephila phyleus 14(N,S), Polites sabuleti 7(N,S), Pyrgus communis 17(C,S), Erynnis tristis 7(N,S). Larvae seen: P. zelicaon 3 (on Foeniculum vulgare), Battus philenor 100+ (on Aristolochia californica), Icaricia icarioides 5 (Lupinus, no adults seen). Total 45 spp., about 1612 individuals.

Willow Slough, Yolo County, CA. 38°34'N, 121°44'W, center 2.6 km N of Slide Hill Park, Davis. Habitat coverage: see earlier reports. 4 July 1979; 1145-1530. Clear in A.M., mostly clear in P.M.. 21-28°C, wind SSE, 5-15 km/hr. One observer in 1 party. Total party hours 3-3/4 (all on foot); total party-miles 8 (all on foot). Observer: Arthur M. Shapiro (Dept. of Zoology, Univ. Calif., Davis, CA 95616). Conservation status: see earlier reports. Changes since last year: Water levels and vegetation still good after 115% of normal rainfall this past winter. No grass fires yet in area. Papilio zelicaon 2(S), Pieris rapae 44(S), Colias eurytheme 474(S), Strymon melinus pudica 21(S), Lycaena xanthoides 2(S), L. helloides 9(S), Brephidium exilis 552 (S), Everes comyntas 30(S), Plebeius acmon 12(S), Danaus plexippus 18(S), Phyciodes campestris 167(S,N), P. mylitta 1(N), Vanessa atalanta 1(S), V. cardui 9(S,N), V. carye 8(S), J. coenia 19(S), Atalopedes campestris 7(S), Hylephila phyleus 9(S), Polites sabuleti 1(S), Pholisora catullus 13(S), Pyrgus communis 15(S), P. scriptura 19(S), Erynnis tristis 6(S). Total 23 spp., about 1439 individuals. Larvae seen: Pieris rapae 3 (on Lepidium latifolium), 1 (on Brassica geniculata, Junonia coenia 5 (on Lippia sp.), Papilio zelicaon 1 (on Foeniculum vulgare), Pholisora catullus 2 (on Amaranthus hybridus), Pyrgus communis 1 (Malva sp.)

U.C.L.A. Campus, L.A. Co., CA. 34°04'N, 118°27'W, center SW perimeter U.C.L.A. campus, includes U.C.L.A. campus. Elev. 110-150 m. Habitat coverage: University campus 100%. 8 July 1979; 1215-1900. Partly cloudy, hazy. 22-29°C, wind WSW 0-15 km/hr. One observer in 1 party. Total party-hours 3.5 (3.5 on foot); total party-miles 3 (3 on foot). Observer: William C. Bakewell (10824 Lindbrook Drive, Apt. 309, Los Angeles, CA 90024). Conservation status: University campus. Imminent threats to habitats: None. Changes since last year: Construction is always in progress on U.C.L.A. campus. Papilio rutulus 1(S), Pieris rapae 6(S), Hylephila phyleus 4(S). Total 3 spp., about 11 individuals.

San Joaquin Co., CA. 30°13'N, 121°17'W, center Woodbridge Post Office, includes Lodi, Woodbridge, Acampo, Victor. Elev 0-5 m. Habitat coverage: Streamside woodland by vineyard, Salix, Phragmites (40%); settling ponds by winery, Lotus, Urtica, Salix (30%); Quercus lobata savannah, Sida nederacea, Asclepias (15%); Streamside woodland by city park, Lotus, Salix, Cirsium, located just east of Lodi Lake, City of Lodi (15%; new site). 19 July 1979; 0930-1730. Clear, 30-40°C, no wind. Three observers in 1 party. Total party-hours 7 (5.5 on foot, 1.5 by car); total party-miles 66 (6 on foot, 60 by car). Observers: Kirby Brown (P.O. Box 1809, Stockton, CA 95201), Michael Croce, Robert Langston. Conservation status: Uses of land: same as last year. Uniqueness of habitat: Typical valley streamside, heavy Phragmites, also possibily best Aristolochia location in county; Settling ponds in varying state of dryness provide lush ground cover, wide variety of micro-habitats; Untouched (sort of) Valley Oak grove; "Wilderness" area adjacent to typical city park and lake, has some heavy growth with narrow dirt trails, hiking and bicycle trails, heavy public use. Imminent threats to habitats: One site being developed, but about 50 acres of grove to be left as undisturbed "natural area". Briefly opened to public and closed because of high salt in well water (300 ppm). Artificial lake has over 1000 ppm salt; as concentration increases, threatens to kill many oak trees; Park area owned by City of Lodi and to remain undeveloped except for dirt trails. Changes since last year: Two sites vegetation thicker, access more difficult; Several acres planted to lawn, much of park has been plowed to reduce fire hazard, artificial lake part filled. Battus philenor hirsuta 36(C), Papilio rutulus 17 (C), Colias eurytheme 25(S), Pieris protodice 3(C), P. rapae 100(S), Strymon melinus pudica 6(C), Satyrium sylvinus 2(C), Lycaena helloides 36(C), Brephidium exilis 24(C), Everes comyntas 75(C), Plebejus acmon 14(C), Phyciodes mylitta 5(C), P. campestris 1(C), Vanessa atalanta 6(S), V. virginiensis 2 (C), V. cardui 2(N), Junonia coenia 60(S), Nymphalis antiopa 1(S), Limenitis lorquini 21(C), Danaus plexippus 9 (N), Lerodea eufala 2(C), Ochlodes sylvanoides 36(C), O. yuma 2(C), Polites sabuleti 2(C), Atalopedes campestris 2 (C), Pholisora catullus 62(C), Pyrgus communis albescens 76 (C), P. scriptura 15(C), Erynnis tristis 24(C). Total 29 spp., about 676 individuals. Larvae seen: Danaus plexippus 4 (on Asclepias sp.), Vanessa cardui 10 (on Cirsium vulgare).

Ramsey Canyon, AZ. 26°10'N, 12°20'W, center 2-1/2 mi. ESE Nicksville, AZ, includes eastern flank of Huachuca Mts. north to Brown Canyon, S. to Coronado Natl Monument; east to the San Pedro River and north to 2 miles south of Sierra Visa, AZ. Elev. 1250-2900m.; habitat coverage: 60% mesquite/grassland, Acacia spp., Poa sp.; 20% oak-juniper woodland, Quercus spp.; 10% mixed deciduous canyon; Plantago, Acer ssp.; 6% cottonwood forest, Populus spp.; 4% cultivated fields, Alfalfa. 15 July 1979; 0630-1630. Mostly clear, 18-32°C, wind SW 2-10 km/hr. Sixteen observers in 4 parties. Total party-hours 32 (21 on foot, 11 by car); total party-miles 194 (18.5 on foot, 175.5 by car). Observers: Dean Anderson, Richard Bailowitz, George Balogh, Rick Bowers, Joe Comella, Doug Danforth, Betty Epler, John Epler, Russ Gwynne, Connie Hewett, Rick Hewett (RR1, Box 84, Hereford, AZ 85615), Linda Lamina, Noel McFarland, Chuck McMoran, Bill Pollock, Susan Swain. Conservation status: Uses of land: cattle ranching, crop production, firewood growing, U.S. Forest area, private homes and homesteads. Uniqueness of habitat: Three moist, high elevation mountain canyons within surrounding arid desert grass and mesquite lands; productive agriculture plots (esp. alfalfa) that attract unusual species; coniferous forests in mountain area. Imminent threats to habitats: Development for subdivisions in low elevation areas; possible damage to forested areas; severe run-off damage along creeks and drainage basins. Changes since last year: First year count. Battus philenor 147(N), Papilio polyxenes 2(C), P. multicaudautus 31(N), Colias eurytheme 65(N), C. cesonia 5(N), Eurema nicippe 81(C), E. mexicana 114(N), Nathalis iole 11(N), Neophasia terlootii 1(S), Pieris protodice 1000(N), Callophrys siva 1(S), Ministrymon leda 18(S), Strymon melinus 30(N), Erora quaderna 1(C), Brephidium exilis 2(S), Leptotes marina 192(N), Hemiargus isola 5(N), Celastrina argiolus 22(N), Plebeius acmon 10(C), Emesis zela 19(N), E. ares 2(C), Adelpha bredowii 34(S), Limenitis astyanax 23(N), Junonia coenia 11(N), J. nigrosuffosa 3(S), Anthanassa texana 13(N), Phyciodes mylitta 3(C), Chlosyne lacinia 13(N), Thessalia cyneas 2(C), T. theona 1(C), Polygonia satyrus 1(S), V. virginiensis 9(N), V. cardui 3(S), V. atalanta 2(S), Nymphalis antiopa 8(N), Euptoieta claudia 12(N), Agraulis vanillae 1(N), Danaus gilippus 131(N), D. plexippus 5(S), Libytheana bachmanii 1(N), Paramecera alleni 3(C), Cyllopsis pertepida 15(C), C. henshawi 4 (C), Euptychia rubricata 16(N), Amblyscirtes exoteria 16(C), A. cassus 30(C), A. aenus 6(C), A. fimbriata 27(C), Atrytonopsis lunas 6(C), Poanes taxilis 118(N), Copaeodes aurantiaca 12(N), Pyrgus communis 38(N), Erynnis funeralis 3(C), E. tristis 6(C), E. juvenalis 6(C), Staphylus ceos 7(N), Thorybes pylades 25(C), Autochton cellus 2(S), Epargyreus clarus 6(S), Pyrgus scriptura 1(C), Pholisora alpheus 4(C), Orisma edwardsi 1(C), Hylephila phyleus 7(N), Pholisora catullus 1(N), Amblyscirtes nysa 1(C), Erynnis pacuvius 1(C). Total 65 spp., about 2300 individuals.

ZONE II: NORTHWEST
(Oregon, Alaska)

Portland, OR. 45°20'N, 122°45'W, center Insect Zoo, Washington Park; see 1978 report for description. Habitat coverage: Same as 1978, plus 5% filled, weedy meadowland on the immediate flood plain of Columbia River backwaters, including Multnomah Slough. 26 June 1979; 1000-1900. A.M. mostly clear; P.M. clear, 18-26°C. Wind NE, 0-36 km/hr. Nine observers in 3 parties. Total party-hours 12(9 on foot, 3 by car): total party-miles 25(8 on foot, 17 by car). Observers: Christie Galen, Louise Godfrey, John Hinchliff, Sally Hughes, Thomas J. McConathy (5908 NW Fruit Valley Rd., Vancouver, WA 98660), Lyfe Power, Robert M. Pyle (Swede Park, Loop Rd., Box 123, Gray's River, WA 98621), Michele Schneider, Roger Yerke. Conservation status: Uses of land: Much of it protected from development as city parks, open space or flood plain; but liable to management change. Uniqueness of habitats: Oak Bottoms in particular is a highly significant flower open space incl. meadow uplands and riverside woodlands. Skyline Ridge and associated Forest Park probably consist of one of the most impressive urban open spaces anywhere. Imminent threats to habitats: Off-road vehicle damage on Skyline Ridge and to a lesser extent at Oak Bottoms. Residential development of valley bottomlands. Changes since last year: More of the Tualitin and other valley bottomlands have been built up. Papilio rutulus 56 (S), Pieris rapae 28(S,N), Colias eurytheme 6(S,N), C. philodice 1(S), Limenitis lorquini 8(S), Polygonia faunus 1(S), Vanessa annabella 3(N), V. cardui 15 (S,N), V. atalanta 4(S), Phyciodes mylitta 1(S), Coenonympha ampelos 10(S,N), Lycaena helloides 3(N), Celastrina pseudargiolus 31(S,N). Total 13 spp., about 167 individuals.

Utopia, OR. 44°30'N, 121°0'W, Ctr.:T125 R14E Sec.8; incl. Grizzly Mtn, Crooked River, McMeen Spr., Haystack Res., Lone Pine Cr., Skull Hollow, Cyrus spring and pond. Elev. 2400-5635 ft. Habitat coverage: Sage brush juniper grassland, desert, riparian habitat, ponderosa pine and mixed conifer forest. 15 July 1979; 1000-1800. Clear, 22-35°C, wind all directions, generally calm, 0-30 km/hr. Eighteen observers in 3-5 parties. Total party-hours 40 (30 on foot, 10 by car); total party-miles 248 (60 on foot, 188 by car). Observers: Karen Budwill, Alan Chambers, Pamela Ellis, Charles Fosterling, Christie Galen, Bruce Hansen (OMSI Research Center, 4015 SW Canyon Rd., Portland, Oregon 97221), Ivey Hilte, George Hinckley, Patricia McCafferty, Ginny Newman, Adele Rodriguez, Russell Schieving, Steve Shattuck, Kathy Smith, Becky Smolen, Joan Urilakis. Conser-

vation status: Uses of land: Grazing, recreation, some homes. Uniqueness of habitats: Many of the streams of the Crooked River National Grassland are fenced to exclude cattle. The resulting riparian vegetation is unique since most of it has long since been eaten up. Imminent threats to habitats: Almost all land is managed by the Forest Service. They are just completing a management plan. Private land is being developed and one riparian site on Grizzly Mtn. has recently been developed and posted no trespassing. Changes since last year: first year count. Papilio multicaudata, P. zelicaon, P. rutulus, Pieris bekerii, P. occidentalis, Colias occidentalis, C. eurytheme, Plebejus acmon, P. melissa, P. icarioides, Glaucopsyche piasus, G. lygdamus, Everes comyntus, Strymon melinus, Satyrium sylvinus, S. behrii, Lycaena helloides, Coenonympha tullia, Cercyonis pegala, C. oetus, Vanessa cardui, V. annabella (?), V. atalanta, Limenitis lorquini, Nymphalis antiopa, Polygonia zephyrus, Speyeria hydaspe (?), Phyciodes mylitta, Hesperia juba. Total 29 spp.

Eagle Summit, AK. 65°31'N, 145°22'W, includes vicinity of Eagle Summit, 100 km SW Circle, Miller House and Berry Camp. Elev. 600-1650 m; habitat coverage: Alpine tundra and swales (90%), alpine rockslides (10%). 2 July 1979; 1030-1700. Clear, 15-20°C (estimate), wind 0-5 km/hr. Thirty-seven observers in 22 parties. Total party-hours 121 (121 on foot); total party-miles 44 (44 on foot). Observers: K. Bagdonas, D.L. Bauer party (4), U. Caspi, D. Faulkner, G. Gorelick, M. Harrington, J. Hinchliff, E. Hodges, R. Hodges, F. Karpuleon, B. Landing, R. Langston, R. Leuschner & son, J. Merritt (2), J. Mori, P. Opler (U.S. Fish & Wildlife Service (OES), Washington, D.C. 20240), W. Patterson, K. Philip, J. Powell, K. Stanford, L. Stanford, R. Stanford, (720 Fairfax St., Denver, CO 80220), S. Stanford, D. Tilden, H. Tilden, W. Tilden, R. Vanderhoff, C. Wilkinson, B. Zeligs, J. Zeligs & daughter. Conservation status: Uses of land: Presently in wild state. Uniqueness of habitat: Widespread arctic. Imminent threats to habitats: None. Changes since last year: Species with adult flights every other year were all in flight. Parnassius eversmanni thor 13, Papilio glaucus arcticus 9, P. machaon aliaska 45, Pieris napi 104, P. occidentalis nelsoni 36, Euchloe creusa 1, Colias hecla glacialis 119, C. gigantea 4, C. palaeno chippewa 67, C. nastes aliaska 174, Plebejus saepiolus amica 1, Vacciniina optilete yukona 17, Agriades glandon nr. bryanti 32, Limenitis arthemis rubrofasciata 2, Polygonia gracilis 1, Nymphalis antiopa hyperborea 2, Phyciodes campestris 1, Boloria napaea alaskensis 117, B. improba youngi 150, B. polaris 137, B. distincta 10, B. chariclea butleri 289, B. eunomia triclaris 20, Oeneis jutta alaskensis 3, O. polixenes yukonensis 49, O. melissa 12, Erebia fasciata 9, E. magdalena mackinleyensis 43, E. youngi 413, E. theano canadensis 6, E. rossii gabrieli? 1, Hesperia comma manitoba 3. Total 32 spp., about 1884 individuals.

ZONE III: ROCKY MOUNTAINS
(Colorado, Wyoming)

Rocky Mtn. National Park, CO. 40°20'N, 105°40'W, center at Bear Lake, RMNP. For further description, see 1978 report. 4 July 1979; 0900-1900. Mostly clear, 16-21°C, wind W, 0-20 km/hr. Four observers in 1-2 parties. Total party-hours 14 (12 on foot, 2 by car); total party-miles 28 (8 on foot, 20 by car). Observers: Barb Browne, Molly Muller, Josie Quick, Robert M. Pyle (Swede Park, Loop Rd., Box 123, Gray's River, WA 98621). Conservation status: Uses of land, Uniqueness of habitat, Imminent threats to habitats, and Changes since last year: see 1978 report. Parnassius phoebus 73(S,N), Papilio gothica 1(N), P. rutulus 13(S,N), Euchloe ausonides 5(N), Pieris rapae 13(N), P. occidentalis 9(N), Colias eurytheme 10(S), C. alexandra 19(S,N), Plebejus acmon 8(N), P. saepiolus 5(N), P. aquilo 2(N), P. icarioides 1(N), Euphilotes spp. 8(N), Glaucopsyche lygdamus 3(N), Coenonympha ochracea 45(S,N), Nymphalis antiopa 1(S), N. milberti 1(N), Polygonia zephyrus 1(N), V. cardui 31(S,N), Phyciodes tharos 14(S,N), P. campestris 8(N), Chlosyne nycteis 30(S,N), C. palla 4 (S,N), Euptoieta claudia 3(N), Speyeria atlantis 1(N), Erynnis spp. 16(S,N), Pyrgus communis 1(N), Oarisma garita 4(N). Total 28 spp., about 314 individuals.

Cottonwood Pass, CO. 38°40'N, 106°45'W, center Cottonwood Pass Summit, San Isabel Natl. For., includes N .5 km to peak top, W 0.5 km to ridge top, E 1 km to peak top, and S 2 km ridge top to valley bottom. Elev. 3656-3750 m. Habitat coverage: 72% alpine tundra, 20% alpine talus slope, 8% willow bog. 30 July 1979; 1000-1400. A.M. clear, P.M. mostly cloudy, 18-24°C, wind NW, 13-35 km/hr. Eight observers in 6-8 parties. Total party-hours 28 (28 on foot); total party-miles 28.5 (28.5 on foot). Observers: Karōlis Bagdonas (Dept. of Zoology and Physiology, Univ. of Wyoming, Laramie, WY 82071), William Bagdonas, John Carlisle, Teresa Clifford, Mark Harrington, Alice Houston, Mike Rehg, Angela Tebaldi. Conservation status: Uses of land: Pass summit parking area, hiking and bakcpacking trails. Uniquesness of habitat: Exceptionally beautiful alpine pass on the Continental Divide with heavy tourist traffic. Imminent threats to habitats: Extensive tundra and trail damage due to abnormal amounts of moisture and heavy tourist traffic. Damage is most extensive near the Continental Divide parking lot. Trash litters the eastern slope. Changes since last year: The 1979 alpine season was two weeks behind the 1978 season; and the 1978 season was two weeks behind normal. The 1979 season was much delayed by last winter's heavy snows and cold temperatures during the 1979 alpine summer. In 1979, there were 33 species compared to 30 species in 1978. Parnassius phoebus 70(C,S), Pieris protodice 1(C), P. sisymbri 1(C), P. napi 5(C,S), Colias eurytheme 6(C,S), C. meadii 65(C,S), Anthocaris sara 1 (C), Euchloe olympia 1(C), Plebejus saepiolus 22(C,S), P. shasta minnehaha 83(C,S), P. glandon rustica 27(C,S), Lycaena cupreus snowi 28(C,S), Oeneis brucei 1(C), O. taygete 1(C), O. chryxus 13(C,S), O. uhleri 2(C,S), Erebia epipsodea 21(C,S), E. magdalena 29(C,S), E. callias 79(C,S), Coenonympha tullia 6(C,S), Vanessa cardui 13(C,S), Nymphalis antiopa 2(S), N. milberti 14(C,S), Polygonia zephyrus 6(C,S), Boloria titania helena 5(C,S), B. bellona toddi 14(C,S), Speyeria mormonia 7(C,S), Euphydryas anicia capella 32 (C,S), Chlosyne damoetus damoetus 40(C,S), Polites draco 3(C), Pyrgus centaureae 19(C,S), P. communis 3(C,S). Total 33 spp., about 630 individuals.

Paonia Reservoir, CO. 39°57'N, 107°21'W, center west shore at midpoint of Paonia Reservoir, includes N. 1 km along road, S 1 mi to turnoff to Kebler pass, E to camp Id-Ra-Ha-Je and Erickson Springs Campground on Gunnison National Forest boundary. Paonia Reservoir is W boundary. Elev. 1920-1950 m. Habitat coverage: 40% stream bed with bordering willow-cottonwood stands, 30% weedy slopes along dirt road, 15% scrub forest bordering reservoir, 15% bog and marsh. 20 July 1979; 1400-1600. Mostly clear, 29-32°C, wind from NW, 5-16 km/hr. Four observers in 2-4 parties. Total party-hours 11.8 (8.3 on foot, 2.5 by car); total party-miles 16 (13.5 on foot, 2.5 by car). Observers: John Carlisle, Mark Harrington, (Dept. of Zoology and Physiology, c/o Dr. Karōlis Bagdonas, Univ. of Wyoming, Laramie, WY 82071), Alice Houston, Michael Rehg. Conservation status: Uses of land: Recreation including hiking, camping and fishing. Also heavy grazing by cattle. Much of the prime habitat bordering Paonia reservoir has been under heavy road construction which will likely continue over the next couple of years. Uniqueness of habitats: Dry scrub oak forest bordering stream woodland. Imminent threats to habitats: Road construction since first observed in 1977 has continued to destroy much of the habitat bordering Paonia reservoir. Construction over the next several years will continue to destroy more prime habitat surrounding the reservoir. Changes since last year: Increased road construction with the resulting loss of more lake border habitat. Much dryer than last year. Population numbers down and less species diversity for 1979. Papilio rutulus 19(C,S), P. multicaudata 12(C,S), Pieris protodice 70(C,S), Colias eurytheme 65(C,S), Nathalis iole 1(C,S), Plebejus saepiolus 12(C,S), Lycaena rubidus 1(C,S), L. dorcus 7(C,S), L. arota 1(C,S), Strymon sylvinus 3(C,S), Cercyonis pegala 10(C,S), C. oetus 25(C,S), Coenonympha tullia ochracea 2 (C,S), Danaus plexippus 2(S), Vanessa cardui 16(C,S), Nymphalis antiopa 1(C), Limenitis weidemeyeri 2(S), Speyeria cybele 10(C,S), S. atlantis electa 2(C,S), S. atlantis nikias 10(C,S), S. callippe meadii 8(C,S), S. mormonia eurynome 10 (C,S), Boloria bellona toddi 13(C,S), Erynnis persius fredericki 6(C,S), E. telemachus 2(C), Polites draco 1(C), Thorybes mexicana nevada 10(C), Ochlodes sylvanoides napa 1 (C). Total 28 spp., about 399 individuals.

Weston Pass, CO. 39°8'N, 106°11'W, center 2 km NW Weston Pass, Pike National Forest, includes 1 km N and S from valley bottom to 1.5 km E to summit of alpine ridge, 1 km W to ridge summit. Elev. 3480-3721 m. Habitat coverage: 45% alpine tundra, 30% talus slope, 15% stream bed-willow thicket, 10% spruce forest. 29 July 1979; 1030-1430. Mostly cloudy, light drizzle, 18-21°C, wind NW, 7-35 km/hr. Ten observers in 9-10 parties, Total party-hours 27(27 on foot); total party-miles 69(69 on foot). Observers: Karõlis Bagdonas (Dept. of Zoology and Physiology, Univ of Wyoming, Laramie, WY 82071), William Bagdonas, John Carlisle, Teresa Clifford, Mark Harrington, Alice Houston, Chuck Lanham, Marylin Lanham, Mike Rehg, Angela Tebaldi. Conservation status: Uses of land and uniqueness of habitat: see 1978 report. Imminent threats to habitats: Increased traffic along primitive road. More importantly, increased unrestricted traffic along four-wheel drive roads. This unrestricted traffic has resulted in permanent damage which is observable from the slopes. Changes since last year: The alpine season was at least 2 weeks behind 1978 season and about 3-4 weeks behind normal. There were 35 species in 1979, compared with 30 in 1978. Parnassius phoebus 133(C,S), Papilio zelicaon 1(C), Pieris protodice 2(S), P. napi 9(C,S), C. philodice 2(C,S), C. meadii 120(C,S), C. scudderii 1(C,S), C. alexandra 2 (C,S), Anthocaris sara 1(C,S), Euchloe ausonides 1(C,S), Nathalis iole 1(S), Glaucopsyche lygdamus 2(C,S), Plebejus saepiolus 38(C,S), P. shasta minnehaha 97(C,S), P. glandon rustica 27(C,S), Lycaeides melissa 1(C), Lycaena dorcas 8(C,S), Lycaena cupreus snowi 8(C,S), Oeneis taygete 1(C), O. chryxus 3(C,S), O. uhleri 3(C), Erebia epipsodea 23 (C,S), E. magdalena 18(C,S), E. callias 143(C,S), Vanessa cardui 29(C,S), Nymphalis milberti 4(C,S), Polygonia zephyrus 7(C,S), Euptoieta claudia 1(C), Boloria titania helena 38(C,S), Speyeria mormonia 22(C,S), Euphydryas anicia capella 80(C,S), Chlosyne damoetus damoetus 25(C,S), Erynnis persius 2(C), Polites draco 16(C,S), Pyrgus centaureae loki 4(C). Total 35 spp., about 873 individuals.

Hall Valley, CO. 39°28'N, 105°48'W, center Hall Valley Campground, Pike National Forest, includes general area of campground on N and S limits, W 1 km, E 3 km from center along road in narrow Hall Valley. Elev. 2928-2952 m. Habitat coverage: 50% montane meadow, 30% spruce and aspen forest, 20% willow bog. 31 July 1979; 0830-1200. Mostly clear, 13-29°C, wind NW, 5-15 km/hr. Six observers in 5-6 parties. Total party-hours 17.5 (17.5 on foot); total party-miles 10 (10 on foot). Observers: Karõlis Bagdonas (Dept. of Zoology and Physiology, Univ. of Wyoming, Laramie, WY 82071), William Bagdonas, John Carlisle, Teresa Clifford, Alice Houston, Mike Rehg. Conservation status: uses of land and uniqueness of habitat: see 1978 report. Imminent threats to habitats: Overgrazing in 1978 was heavy. In 1979, even with heavier rainfall and lusher growth, habitat destruction was even greater than in 1978. Changes since last year: Botanical growth averaged two weeks below 1978. At time of 1979 count the flora was in full bloom for a montain habitat at this elevation. Clearly it was 3-4 weeks behind the norm. In 1979 38 species were recorded compared to 32 species in 1978. Parnassius phoebus 20(C,S), Papilio rutulus 3(C,S), P. multicaudata 1(C), P. zelicaon 1(C), Pieris occidentalis 5(C,S), P. protodice 1(C), P. rapae 2(C), P. napi 52(C,S), Colias eurytheme 7(C,S), C. philodice 2(C), C. scudderi 3(C), C. alexandra 26(C,S), Euchloe ausonides 4(C,S), Glaucopsyche lygdamus 22(C,S), Plebejus saepiolus 59(C,S), P. glandon rustica 8(C,S), Lycaeides melissa 3(C), Lycaena rubidus 16(C,S), L. dorcas 31(C,S), Oeneis chryxus 2(C,S), Erebia epipsodea 15(C,S), Coenonympha tullia 27(C,S), Vanessa cardui 24(C,S), Limenitis weidemeyeri 16(C,S), Polygonia zephyrus 4(C,S), Boloria titania helena 2(C), Speyeria atlantis 3(C,S), S. mormonia 57(C,S), S. zerene 8(C,S), Phyciodes campestris 36(C,S), P. mylitta 1(C), P. tharos 2(C), Erynnis persius 4(C,S), Orisma garita 4(C,S), Polites draco 15(C,S), P. sonora utahensis 3(C), Pyrgus centaureae loki 4(C,S). Total 38 spp., about 695 individuals. Larvae seen: Nymphalis milberti 57 (on Urtica dioica).

Kebler Pass-Erickson Springs, CO. 38°52.5'N, 107°12.5'W, center Lost Lake campground. See earlier reports for description. 1 August 1979, 0915-1345. Clear, 24°-30°C, wind variable, 0-5 km/hr. One observer in 1 party. Total party-hours 4.5(2.5 on foot, 2 hitch-hiking); total party-miles: 33 (8 on foot, 25 hitch-hiking). Observer: Lawrence F. Gall (Dept. of Biology, 360 B OML, Yale Univ., New Haven, CT 06520). Conservation status, uniqueness of habitat and imminent threats to habitat: see 1978 report. Changes since last year: Late season at lower elevations, otherwise no big changes. Migrant Colias eurytheme having a large population explosion. Papilio rutulus 7(N), Colias eurytheme 85+(N), C. scudderi 4(S), C. eriphyle 1 (S), Nathalis iole 2(C), Euchloe ausonides 1(S), Pieris rapae 3(S), P. protodice 20+(N), P. napi 1(S), Hypaurotis crysalus 37+(C), Harkencleuus titus 1(C), Satyrium liparops liparops 3(C), S. calanus godarti 22(C), S. californica 2(C), Lycaena arota 1(C), L. rubidus 2(S), L. heteronea 15(S), L. nivalis 1(N), L. dorcas 1(S), Plebejus icarioides 1(N), Agriades glandon 3(S), Coenonympha tullia 2(S), Cercyonis pegala 24(C), C. oetus 20(S), Euptoieta claudia 2(S), Speyeria mormonia 45+(S), S. atlantis 6(N), S. aphrodite 4(N), S. cybele leto 12(N), S. callippe 13(N), S. edwardsii 3(N), Boloria titania 1(N), Chlosyne palla 1(S), Phyciodes campestris 2(N), Nymphalis milberti 1(S), Vanessa cardui 7(S), Limenitis weidemeyerii 6(S), Pyrgus communis 1(S), Thorybes mexicana 4(S), Hesperia comma 7(C), Ochlodes sylvanoides 9(C). Total 41 spp., about 393+ individuals.

Highline Canal, CO. 39°45'N, 104°40'W, center at The Hollow Tree, Del Mar Park, Aurora. See previous reports for description. 12 July 1979; 1000-1600. A.M. clear; P.M. partly cloudy, light rain; 24-35°C, wind various, 0-10 km/hr. Eight observers in 2 parties. Total party-hours 12(10 on foot, 2 by car); total party-miles 20 (10 on foot, 10 by car). Observers: Amy Chu, Jan Chu, Mary Jane Foley, Carol Jones, Lynell Jones, Robert M. Pyle (Swede Park, Loop Rd., Box 123, Gray's River, WA 98621), Josie Quick, Ron Wahl. Conservation status: Uses of land: Residential, open space, cemetary, watershed, recreational. No longer any real agricultural land in the count circle. Uniqueness of habitat: Highline Canal is unique as a biogeographical corridor between the Colorado Front Range and the High Plains, which runs through the city and suburbs. Associated open space is among the last such in the greater Denver conurbation. Imminent threats to habitats: Extremely rapid and seemingly insatiable growth for residential and commercial purposes. Off-road vehicle use, especially in the highly diverse Sand Creek/Highline Canal intersection area. Overzealous landscaping practices of park and water board authorities. Changes since last year: Two very prominent changes. First, the very productive section between the canal and Chambers and Potomac Rds and 6th Avenue, where we saw fox and P. interrogationis last year has been completely tract-developed. This spells the end of one of the last great habitat hold-outs in Aurora. Second, the very center-point landmark of the count circle, the great hollow cottonwood tree in Del Mar Park (which saved the compiler's life in a cataclysmic hailstorm in 1954), has been removed. At first the Aurora Parks Department was suspected of malicious institutionalized vandalism, but it has since been learned that the massive tree split in a heavy snowstorm last winter and hence had to be removed in the opinion of the city forester. The circle will remain the same in spite of these bad auguries. Papilio polyxenes 5(S,N), P. rutulus 20(S,N), P. multicaudatus 3(S), Pieris rapae 3632 (S,N), P. protodice 24(S,N), Colias eriphyle 25(S,N), C. eurytheme 11(S,N), Strymon melinus 4(S,N), Lycaena dorcas 1(S,N), L. xanthoides 17(S,N), L. rubidus 25(S,N), Plebejus melissa 2(S,N), Cercyonis pegala 91(S,C), Danaus plexippus 20(S,N), Asterocampa celtis 15(S,N), Limenitis weidemeyerii 9(S,N), L. archippus 3(S,N), Nymphalis antiopa 22(S,N), Vanessa cardui 42(S,N), V. atalanta 3(S), Chlosyne gorgone 112(S,N), Euptoieta claudia 4 (S,N), Speyeria aphrodite 1(N), Epargyreus clarus 11 (S,N), Pyrgus communis 19(S,N), Pholisora catullus 5(S,N), Piruna pirus 21(S,N), Poanes taxiles 6(S,N). Total 28 spp., about 4163 individuals.

Maroon Lake, Aspen, CO. 39°6'N, 107°56'W, center N shore Maroon Lake, White River Natl. Forest, includes N, S, and E shores of Maroon Lake, W to Crater and Willow lakes and Maroon Peak. Elev. 2987-3091 m. Habitat coverage:46% subalpine meadow,29% montane meadow,10% stream wetland,[illegible]% aspen-willow thicket. 21 July 1979; 1000-1430. A.M. partly cloudy, P.M. mostly cloudy. 22-26°C, wind NW 8-16 km/hr. Four observers in 2-4 parties. Total party-hours 19 (19 on foot); total party-miles 14(14 on foot). Observers: John Carlisle, Mark Harrington (Dept. of Zoology and Physiology, c/o Dr. Karölis Bagdonas, Univ of Wyoming, Laramie, WY 82071), Alice Houston, Michael Rehg. Conservation status: Uses of land: Heavy use area. National Forest recreation area with both tent and trailer camping nearby. Heavy hiking and fishing use. Uniqueness of habitats: lush meadow and river valley surrounded by sheer rock walls. One of the most scenic in Colorado. Imminent threats to habitats: Heavy use by hikers has caused environmental damage in some areas. New fences have been constructed by Forest Service since 1978 to prevent hikers from using side trails and to prevent further damage to meadows. Traffic restricted on the roads in an attempt to promote recover of damaged areas. Changes since last year: Both flora and fauna were about 2-3 weeks behind the 1978 season. Not as green or lush as 1978. Many species numbers were down this year. Papilio rutulus 7(C,S), Pieris protodice 7(C,S), P. napi 8(C,S), Colias eurytheme 1(S), C. philodice 6(C,S), C. alexandra 1(S), Euchloe ausonides 40(C,S), Glaucopsyche lygdamus 7(C,S), Everes amyntula 10(C,S), Plebejus saepiolus 25(C,S), P. glandon rustica 6(C,S), Lycaeides melissa 1(C), Lycaena rubidus 1(C), Erebia epipsodea 11(C,S), E. magdalena 2(S), Oeneis chryxus 8(C,S), Cercyonis oetus 1(C), Coenonympha tullia ochracea 27(C,S), Vanessa cardui 16(C,S), Nymphalis milberti 5(C,S), Limenitis weidemeyeri 2(C,S), Speyeria mormonia eurynome 40(C,S), Euphydryas anicia capella 50(C,S), Thorybes mexicana 5(C,S), Erynnis persius 2(C,S), Polites draco 2(C,S), Pyrgus communis 1(C). Total 27 spp., about 383 individuals.

Gilpin County, CO. 39°50'N, 105°20'W, (Lower circle)Ctr. Golden Gate Cyn St Pk., includes mouth of Coal Creek Canyon, Golden Gate Canyon State Park, Golden, Mt. Zion. See previous reports for further description. 7 July 1979; 0830-1800, 18-32°C, wind 10-15 km/hr. Five observers in 2 parties. Observers: Diane Epstein, Marc Epstein (667 Simpson, St. Paul, MN), Robert Price, Mark Schoen, Michael Young. Conservation status: Uses of land, Uniqueness of habitat, and Imminent threats to habitats: see previous reports. Changes since last year: This year is later than last, probably by 2 weeks. More vegetation. Parnassius phoebus sayii 125(S), Papilio indra 6(C), P. zelicaon 1(C), P. multicaudatus 4(C), P. eurymedon 2(C), P. rutulus 1(S), P. polyxenes asterius 1(C), Pieris rapae 1(C), P. protodice 78(C), Euchloe ausonides coloradensis 1(C), Colias philodice eriphyle 1(C), C. eurytheme 1(C), C. alexandra 1(C), Lycaena rubidus 9(C), L. heteronea 46(C), Satyrium behrii crossi 2(C), S. saepium 1(C), Callophrys apama homoperplex 4(C), C. siva 1(C), Strymon melinus 2(C), Harkenclenus titus 3(C), Celastrina argiolus 1(C), Euphilotes enoptes ancilla 156(C), Plebejus acmon 8(C), P. melissa 3(C), P. icarioides lycea 13(C), Glaucopsyche piasus 4(C), G. lygdamus oro 2(C), Everes amyntula 1(C), Apodemia nais 55(C), Coenonympha tullia ochracea 40(C), Cercyonis oetus charon 52(C), Neominois ridingsii 1(C), Oeneis chryxus 1(C), O. uhleri 2(C), Erebia epipsodea 8 (C), Asterocampa celtis montis 3(C), Limenitis weidemeyeri 10(C), Polygonia zephyrus 12(C), Nymphalis antiopa 20(C), N. californica 15(C), N. milberti 1(C), Vanessa cardui 10(C), V. atalanta rubria 4(C), Euphydryas anicia capella 12(C), Speyeria coronis halcyone 1(C), S. atlantis hesperis 33(C), S. callippe meadi 61(C), S. aphrodite ethne 44(C), S. edwardsi 2(C), Euptoieta claudia 7(C), Chlosyne gorgone carleta 4(C), Phyciodes campestris camillus 2(C), P. tharos 2(C), P. pallida 2(C), Danaus plexippus 1(C), Oarisma garita 5(C), Piruna pirus 3(C), Euphyes vestris 15(C), Hesperia viridis 2(C), Erynnis persius fredericki 5(C), E. martialis 5(C), Amblyscirtes phylace 2(C), Polites manataaqua rhena 1(C), P. themistocles 3(C), Pyrgus communis 1(C). Total 66 spp., about 906 individuals.

Gilpin County, CO. 39°58'N, 105°30'W, (Modified upper circle, fifth annual) center 8 km SE of Apex on N Clear Creek Rd, includes East Portal, Rollinsville, Central City, Idaho Springs, western portion of Golden Gate State Park, Dory Hill, North Clear Creek Canyon. Elev. 2200-2900 m.. Habitat coverage: subalpine meadows and bogs (30%), Canadian Zone forest (40%), Transition Zone forest (30%), 22 July 1979; 1000-1630. Partly cloudy, 11-31°C, wind variable, calm to 10 km/hr. Eight observers in 2 parties, Total party-hours 9(6 on foot, 3 by car); total party-miles 44(8 on foot, 36 by car). Observers: Peter Erickson, Sally Erickson, Linus Erickson (age 5), Janira Erickson (age 7), Ray E. Stanford (720 Fairfax St., Denver, CO 80220), Kit Stanford, Linda Stanford (age 12), Scott Stanford (age 9). Conservation status: Uses of land: Partially at our request, a portion of the last remaining colony of topotypical Boloria selene tollandensis has been fenced off from grazing and posted by the owners. Those desiring permission to collect should contact me. Uniqueness of habitats: see earlier reports. Imminent threats to habitats: None. Changes since last year: none. Papilio rutulus 15(C), P. eurymedon albanus 1(S), P. multicaudatus 2(S), Pieris rapae 2(S), P. napi mcdunnoughi 18(C), P. protodice 7(N), Euchloe ausonides coloradensis 3(N), Colias eurytheme 12(C), C. philodice eriphyle 6(C), C. alexandra 15 (C), C. scudderii 7(C), Eurema nicippe 1(C), Nathalis iole 1(C), P. phoebus sayii 40 (C), Plebejus icarioides lycea 5(C), P. saepiolus whitmeri 75(C), P. glandon rustica 20(C), Glaucopsyche lygdamus oro 2(N), Euphilotes enoptes ancilla 1(N), Everes amyntula 1(N), Lycaena editha montana 6(C), L. rubidus sirius 30(C), L. heteronea colorad. 40(C), L. dorcas castro 20(C), L. nivalis browni 3(C), C. apama homoperlexa 1(N), Strymon melinus 1(C), Coenonympha tullia ochracea 13(C), Cercyonis oetus charon 40(C), Erebia epipsodea 15(C), Danaus plexippus 4(C), Boloria titania helena 6(C), Speyeria edwardsii 5(C), S. coronis halcyone 1(C), S. zerene sinope 1(C), S. atlantis hesperis 10(C), S. mormonia eurynome 30(C), S. aphrodite ethne 3(C), Phyciodes tharos ssp. 15(C), P. campestris camillus 12(C), Chlosyne gorgone carlota 1(N), Nymphalis antiopa antiopa 2(S), N. milberti furcillata 1(C), Polygonia zephyrus 20(C), Vanessa atalanta rubria 1(C), V. cardui cardui 30(C), Limenitis weidemeyeri 20(C), Erynnis persius fredericki 3(C), Pyrgus communis communis 1(N), Euphyes vestris kiowah 5(C), Polites draco 8(C), P. sonora utahensis 1(C), Hesperia comma nr. manitoba 2(C), H. viridis 1(C), Oarisma garita garita 25(C). Total 55 spp., about 611 individuals.

Lost Creek, Grand Teton National Park, WY. 43°45'N, 110°36'W, center Lost Creek Rd., 1 mi E of U.S. Highway 89, includes 1/2 mi N and S of Lost Creek Road from .5 mi to 2.5 mi E of U.S. Highway 89. Elev. 2110-2135 m; habitat coverage: 80% sagebrush flats; 20% moist aspen draws. 7 July 1979; 1230-1530. Clear, 23°-29°C, wind S, 24-56 km/hr. Four observers in 4 parties. Total party-hours 12(12 on foot); total party-miles 15(15 on foot). Observers: M. Sterling Blanche, Alice Houston, Thomas McGann (c/o Dr. Karölis Bagdonas, Univ of Wyoming, Dept. of Zoology and Physiology, Laramie, WY 82071), Michael T. Rehg. Conservation status: Uses of land: Grand Teton National Park. Horse rides through the area twice a day. Very little traffic on Lost Creek Road. Uniqueness of habitats: The vast majority of this study area is sagebrush flats which is characteristic of the flatlands in the southwestern third of the park. Imminent threats to habitats: There are no imminent threats to these habitats that we know of to date. Changes since last year: first year count. Papilio rutulus 1(S), Parnassius phoebus 4(C,S), Pieris napi 1(C,S), Callophrys affinis 2(C), Glaucopsyche lygdamus 1(C), G. piasus daunia 6(C,S), Lycaena heteronea 21(C,S), L. dorcas 2(C), Euphilotes enoptes 31(C,S), Plebejus acmon 33(C,S), P. icarioides 358(C,S), P. saepiolus 3(C,S), Coenonympha haydenii 14(C,S), C. tullia 164(C,S), Erebia epipsodea 11(C,S), Oeneis chryxus 1(C), O. jutta 8(C,S), Euphydryas anicia 7(C,S), E. editha 8(C,S), Limenitis weidemeyerii 3(C,S), Phyciodes campestris, Vanessa cardui 1(C,S), Erynnis persius 7(C,S), Hesperia harpalus 12(C,S). Total 24 spp., about 851 individuals.

Colter Canyon, Grant Teton National Park, WY. 43°56'N, 110° 44'W, center Mouth of Colter Canyon, includes southern ridge of Colter Canyon from Jackson Lake shore, SW to 10333' summit on USGS Maps, E to Jackson Lake and N to starting point. Elev. 2074-3152 m. Habitat coverage: 40% talus slope; 35% burned forest with heavy shrub regrowth; 15% young aspen groves; 10% weedy parks. 3 July 1979; 0800-1600. A.M.: partly cloudy, P.M.: mostly clear. 21-27°C, wind NE, 8-32 km/hr. Three observers in 3 parties. Total party-hours 24 (24 on foot); total party-miles 16.4 (16.4 on foot). Observers: M. Sterling Blanche, Thomas McGann (c/o Dr. Karōlis Bagdonas, Dept. of Zoology and Physiology, Univ. of Wyoming, Laramie, WY 82071), Michael T. Regh. Conservation status: Uses of land: Grant Teton National Park. Hiking and camping are permitted yet there are no established trails into the area and no fires are permitted. A few visitors arrive via boats and usually stay on the shore. Uniqueness of habitats: The forested "lowlands" were burned (lightning) six years ago. The understory is quickly reinvading. The topography is very rugged and rises quickly to a rounded mountain top wich is covered with talus. The area to the east of this mountain has numerous young groves of aspen intermixed with burned areas and weedy parks. Imminent threats to habitats: No imminent threats per se were noted. However, the rapid succession in the burned areas will inevitably change those areas. Changes since last year: First year count. Papilio multicaudata 2(S), P. rutulus 2(C,S), P. zelicaon 7(C,S), Parnassius phoebus 32(S), Anthocaris sara 13(C,S), Pieris napi 23(C,S), P. protodice 3(C,S), P. sisymbrii 23(C,S), Glaucopsyche lygdamus 37(C,S), Plebejus glandon 4(C,S), P. icarioides 3(C,S), Coenonympha haydenii 7 (C,S), Erebia magdalena 53(C,S), Oeneis chryxus 3(C,S), Nymphalis milberti 47(C,S), Boloria kriemhild 2(C,S), Melitaea palla calydon 29(C,S), Euphydryas editha 1(C), Vanessa cardui 3(C,S), Erynnis persius 4(C,S), Carterocephalus palaemon mandan 1(C,S). Total 21 spp. about 332 individuals.

Signal Mountain, Grand Teton National Park, WY. 43°, 51'N, 110°34'W, center Signal Mountain, Emma Matilda Overlook, includes from Emma Matilda Overlook N to Snake River, 1 km SE along south bank of Snake, S to 1.2 km NE Cow Lake, W to a point due S of Jackson Pt. overlook and N to Jackson Pt. Overlook. Elev. 2098-2355 m. Habitat coverage: 75% steep sagebrush slope, 15% aspen groves, 10% coniferous forest. 6 July 1979; 1130-1300. Mostly cloudy, 20-22°C, wind S, 8-30 km/hr. Four observers in 4 parties. Total party-hours: 6 (6 on foot); total party-miles 7(7 on foot). Observers: M. Sterling Blanche, Alice Houston, Thomas McGann (c/o Dr. Karōlis Bagdonas, Dept. of Zoology and Physiology, Univ. of Wyoming, Laramie, WY 82071). Conservation status: Uses of land: Grant Teton National Park. A park road borders the NW border of the study area (leading to several overlooks). The extremely steep grade of the majority of the study area prevents many people from walking through the area. Uniqueness of habitats: The study area is representative of the "hills" covering approximately one-third of GTNP. Imminent threats to habitats: These habitats are protected by the National Park Service and appear very stable. Changes since last year: First year count. Papilio rutulus 2(C,S), Parnassius phoebus 8(C,S), Pieris napi 1(S), Colias spp. 2(S), Callophrys affinis 2(C), Glaucopsyche lygdamus 2(S), G. piasus daunia 31(C,S), Euphilotes enoptes 31(C,S), Plebejus icarioides 74(C,S), Coenonympha haydenii 11(C,S), Nymphalis milberti 6(C,S), Boloria kriemhild 2(C), Melitaea palla calydon 1(C,S), Euphydryas anicia 6(C,S), E. editha 3(C,S), Phyciodes campestris 3(C,S), Limenitis weidemeyeri 4(S), Vanessa cardui 1(C), V. annabella 3, Erynnis persius 3(C,S). Total 20 spp., about 253 individuals.

ZONE IV: GREAT PLAINS
(Manitoba, Nebraska)

Rowe Sanctuary, NE. 98°52'30"N, 40°37'30"W, includes SE 1/4 Sec. 11 R 14W, T8N. Elev. 634-635 m. Habitat coverage: 51% alfalfa, 23% spartina grassland, 26% riparian forest. 7 July 1979; 0930-1200. Clear, 23-27°C. Wind S, 0-5 km/hr. Four observers in 1 party. Total party-hours 3 (by car); total party miles 3(by car). Observers: John C. W. Bliese, Glennis L. Nagel, Harold G. Nagel (Rt. 3, Kearney NE 68847), Grant Newbold. Conservation status: Uses of land: National Audubon Society Bird Sanctuary, 10% cultivated. Bird-watching main use. Uniqueness of habitats: None. Imminent threats to habitats: None. Changes since last year: First year count. Colias eurytheme 23(N), Pieris rapae 22(N), Euchloe olympia 2(N), Strymon melinus 4(N), Everes comyntas 8(N), Cercyonis pegala ino 20(N), Danaus plexippus 2(N), Phyciodes tharos 5(N), Vanessa atalanta 5(N), V. cardui 4(N), Euptoieta claudia 3(N), Speyeria cybele 1(N), S. idalia 32(N), Atalopedes campestris 1(N), Pholisora catullus 2(N), Pyrgus communis 15(N). Total 16 spp., about 149 individuals.

Churchill, Manitoba 59°0'N, 94°15'W, center the town of Churchill, includes a radius of 12 km from 4 km E of airport to Churchill River and 3 km S. Elev. 1-15 m. Habitat coverage: Heath meadow, hummock tundra, Taiga bog, wet sedgemeadow, open spruce tammarack forest to low eskers. 4 July 1979; 0900-1600. Mostly clear, 15-23°C, wind NE, 5-17 km/hr. One observer in 1 party. Total partyhours 7 (6 on foot, 1 by car); total party-miles 20(15 on foot, 5 by car). Observer: David K. Parshall (4424 Rosemary, Columbus, OH 43214). Conservation status: see 1978 report. Uniqueness of habitat, imminent threats to habitats, changes since last year: None. Colias palaeno 1(C), C. nastes 5(C,S), Plebejus aquilo 1(C), Oeneis melissa 12 (C), O. polixenes 17(C), O. jutta 33(C), Boloria polaris 38(C), B. eunomia 14(C), B. frigga 8(C,S), B. titania 1, Erebia disa 6(C), E. discoidalis 4(C), E. rossii 9(C), Pyrgus centaurae 3(C). Total 14 spp., about 152 individuals.

ZONE V: MIDWEST
(Kentucky)

Oldham County, KY. 38°21'N, 85°30'W, includes Brownsboro, Ky. area--along dirt road into Horner Wildlife Sanctuary. Elev. 500-700 ft. Habitat coverage: dirt road with bare open areas, denese mesic forest and clearings. 22 June 1979; 1200-1330. Mostly clear, 60-80°F. Two observers in 1 party. Total party hours 1.5 (by car). Total party-miles: 3(on foot). Observers: W. Blaine Early III, C. V. Covell (Dept. of Biology, Univ of Louisville, Louisville, KY). Conservation status: Uses of land: Undeveloped to use as stone quarry; dirt road. Uniqueness of habitat: none listed. Imminent threats to habitats: Further stone quarrying; possible eventual residential development. Changes since last year: None readily observable. Papilio glaucus 1(S), P. troilus 2(C,S), Graphium marcellus 3(C,S), Pieris rapae 13(S), Colias eurytheme 6(S), C. philodice 4(S), Harkenclenus titus mopsus 4(C,S), Satyrium liparops strigosa 2(C), S. calanus falacer 5(C), S. edwardsii 8(C), Everes comyntas 4(S), Celastrina argiolus pseudarg. 2(S), Euptychia cymela 2(S), Astero campa celtis 5(S), A. clyton 3(S), Vanessa atalanta 2(C), V. virginiensis 1(S), Nymphalis antiopa 1(C), Polygonia interrogationis 15(C,S), P. comma 2 (C,S), Phyciodes tharos 4(S), Boloria bellona 1(C), Speyeria cybele 8(C,S), Poanes zabulon 1(S), Atrytone delaware 2(C), Polites themistocles 4(C), Ancyloxipha numitor 1(S), Nastra lherminier 1(C), Thorybes sp. 1(S), Epargyreus clarus 2(S), Battus philenor 2(S). Totoal 31 spp., about 112 individuals.

ZONE VI: SOUTHEAST
(Florida, Louisiana, Mississippi, Virginia)

Big Black Mountain, KY/VA. 37° N, 83° W, includes Cumberland, Benham, Lynch, all Harlan Co., KY; Big Black Mtn; along creek 4 road miles S of Big Black Mtn, Wise Co., VA. Elev. 1070-1260 m. Habitat coverage: Forest and clearings at summit of Kentucky's highest peak. 10 July 1978; 0900-1500. A.M.: Clear. P.M.: Mostly clear. 21-27°C, wind variable, 0-10 km/hr. Nineteen observers in 8 parties. Total party-hours 48 (40 on foot, 8 by car); total party-miles 120(16 on foot, 104 by car). Observers: Richard Henderson, David Hess, Leroy Koehn, McInnis (2 in party), Paul Opler (2 in party), Floyd and June Preston, Steve and Grayson Spomer, Ray, Kit, Linda, and Scott Stanford (720 Fairfax St., Denver, CO 80220), Bill and Hazel Tilden, party of two from Ohio. Conservation status: Uses of land: Mostly second-growth forest; some urban and rural areas. Uniqueness of habitats: Classic and unusually good habitats for Erora laeta and Speyeria diana. Imminent threats to habitats: Strip-mining. Changes since last year: none noted. Battus philenor 92(C), Papilio polyxenes asterius 1(N), P. troilus 8(S), P. glaucus 8(N), Graphium marcellus 9(C), Pieris rapae 11(N), Colias philodice 16(N), C. eurytheme 18(N), P. sennae eubule 1(C), Satyrium falacer 3(C), S. edwardsii 1(C), Danaus plexippus 8(N), Limenitis archippus 1(S), L. astyanax 1(C), Polygonia interrogationis 8(C), P. comma 3(N), Nymphalis antiopa 2(S),V.a.rubria 10(S), V. virginiensis 1(S), V. cardui 1(S), Phyciodes tharos 17(C), Chlosyne nycteis 2(C), Boloria toddi ammiralis 15(C), Speyeria diana 19(C), S. cybele 88(C), S. aphrodite 17(C), Erora laeta 22(C), Strymon melinus 1(C), Everes comyntas 22 (C),Celastrina argiolus pseudargiolus 8(C), Asterocampa celtis 2(S), Epargyreus clarus 76(C), Pholisora catullus 3(C), Amblyscirtes vialis 3(C), Pompeius verna 2(C), Wallengrenia egeremet 6(C), Euphyes vestris metacomet 2(C), Ancyloxypha numitor 2(S). Total 38 spp., about 510 individuals.
[1978 report not received by count coordinator in 1978.]

Reddish Knob, VA-WVA. 38°31'N, 79°12'W, includes Shenandoah Mountain in George Washington National Forest including Reddish Knob, forest service roads and portion of U.S. Highway 33. Town of Sugar Grove, WVA. Elev. 460-1345 m. Habitat coverage: Abandoned farm and stream (70%), Devonian shale barrens (10%), deciduous woods (10%), roadside in farmland (10%). 18 July 1979; 0800-1630. A.M. Mostly cloudy. P.M. Partly cloudy. 19-27°C. W, 0-5 km/hr. One observer in 1 party. Total party-hours 8.5 (6.5 on foot, 2 by car); total party-miles 46 (6 on foot; 40 by car). Observer: Paul A. Opler (Office of Endangered Species, U.S. Fish and Wildlife Service, Washington, D.C. 20240). Conservation status: Uses of land: Mostly in National Forest, but some in white pine plantations, abandoned farms, crops, or grazing land. Uniqueness of habitats: The shale barrens habitat extends only from southern Pennsylvania to southern Virginia and is home to several endemic plants. Locally rare butterflies such as Erynnis brizo, Euchloe olympia and Glaucopsyche lygdamus fly here in the spring. Imminent threats to habitats: None. Changes since last year: None. Battus philenor 7(S), Papilio polyxenes 2(S), P. glaucus 3(S), P. troilus 4(S), Pieris rapae 49(S), Colias philodice 78 (S), C. eurytheme 9(S), Lycaena phlaeus 7(S), Satyrium edwardsii 1(S), S. calanus 9(C), Strymon melinus 1(S), Harkenclenus titus 8(S), Everes comyntas 16(S), Celastrina argiolus 2(S), Polygonia comma 4(S), P. progne 5(C), Vanessa virginiensis 2(S), V. atalanta 1(S), Speyeria cybele 279(S), S. aphrodite 85(S), Boloria bellona 13(S), Phyciodes tharos 27(C), Phyciodes sp. 40(C), Chlosyne nycteis 6(C), Limenitis astyanax 17(S), L. archippus 1(S), Danaus plexippus 6(S), Lethe portlandia 7(S), Euptychia cymela 28(S), Cercyonis pegala 5(S), Epargyreus clarus 224(S), Thorybes pylades 1(S), Nastra lherminier 1(S), Thymelicus lineola 2(S), Polites coras 1(S), Wallengrenia egeremet 24(C), Pompeius verna 3(C), Atrytone delaware 17(C), Euphyes vestris 3(C), Panoquina ocala 1(C). Total 40 spp., about 999 individuals.

Fort Belvoir, VA. 38°41'N, 77°12'W. For further description see 1978 report. 14 July 1979; 0830-1800. A.M.: Mostly cloudy, light drizzle. P.M.: Partly cloudy. 25-28°C, wind SW, 0-8 km/hr. Three observers in 2 parties. Total party-hours 17.25 (15 on foot, 2-1/4 by car); total party-miles 31 (13 on foot, 18 by car). Observers: John H. Fales, Paul A. Opler (Office of Endangered Species, U.S. Fish and Wildlife Service, Washington, D.C. 20240), Irene W. Roberts. Conservation status: see 1978 report. Battus philenor 7(S), Papilio polyxenes 9 (S), P. glaucus 34(S), P. troilus 2(S), Graphium marcellus 1(S), Pieris rapae 195(S), Colias philodice 9(S), C. eurytheme 8(S), Feniseca tarquinius 2(C), Lycaena phlaeus 1(S), Mitoura gryneus 2(S), Strymon melinus 3(S), Harkenclenus titus 2(S), Everes comyntas 71(S), Celastrina argiolus 4(S), Polygonia interrogationis 3(S), P. comma 3(S), Vanessa virginiensis 6(S), V. atalanta 18(S), Junonia coenia 9(S), Speyeria cybele 22(S), Phyciodes tharos 154(S), Limenitis astyanax 24(S), L. archippus 23(S), Asterocampa celtis 1(S), Danaus plexippus 11(S), Lethe appalachia 5(S), Euptychia cymela 77(S), Cercyonis pegala 78(S), Libytheana bachmanni 1(S), Epargyreus clarus 32(S), Thorybes bathyllus 3(N), T. pylades 1(S), Staphylus hayhursti 1(C), Erynnis horatius 38 (C), Ancyloxipha numitor 12(S), Polites origenes 3(C), Wallengrenia egeremet 20(C), Pompeius verna 3(C), Atalopedes campestris 44(S), Atrytone delaware 4(C), Euphyes vestris 1 (C). Total 42 spp., about 947 individuals.

Forman-Kleinpeter, LA. 30°22'N, 91°02'W, for further description see 1977 report. 15 July 1979; 1030-1600. A.M.: Clear. P.M.: Partly cloudy. 27-29°C. One observer in 1 party. Total party-hours 5.5 (5 on foot; .5 by car); total party-miles 11 (10 on foot, 1 by car). Observer: Michael L. Israel (1934 Oleander St., Baton Rouge, LA 70806). Conservation status: Uses of land: see 1977 report. Changes since last year: Another 5% of forest area has been cleared for building construction. Papilio cresphontes 2(S), P. troilus 2(S), Colias eurytheme 1(S), Phoebus sennae 15(S), Eurema lisa 1(N), Strymon melinus 7(S), Euptychia hermes sosybia 21(S), Agraulis vanillae nigrior 2(S), Euptoieta claudia 1(N), Phyciodes tharos 22(S), Polygonia interrogationis 3(S), Junonia coenia 4(S), Limenitis arthemis 1(S), L. archippus 1(S), Anaea andria 3(S), Asterocampa clyton 1(S), A. celtis 1(S), Libytheana bachmannii 7(S), Epargyreus clarus 2(S), Pyrgus communis 23(S), Pholisora hayhursti 1(C), Erynnis horatius 1(S), E. zarucco 2(S), Copaeodes minima 6(N), Hylephila phyleus 19(S), Wallengrenia otho 2(S). Total 26 spp., about 151 individuals.

W.J. Janes Memorial Drive, Copeland, FL. 26°03'N, 81°23'W, center 11.8 km, includes N of Copeland FL along W.J. Janes Memorial Drive (dirt road). Elev. 1.22-1.83 m. Habitat: 80% Big Cypress swampland, 20% grassy prairie--cypress, water, oak, pine, palmettos, palms, etc. 3 July 1979. 0915-1615. Clear, 28-32°C. Wind negligible. Two observers in 1 party. Total party-hours 7 (1 on foot, 6 by car); total party-miles 13 (1 on foot, 12 by car). Observers: James C. Begg (Apt. 1102, 710 N. Ocean Blvd., Pompano Beach, FL 33062), Ada Ginsberg. Conservation status: Uses of land: Property privately owned but under the State of Florida's jurisdiction to preserve environment. Uniqueness of habitats: This area is in the Frakahatchee Strand, a unique swampy environment supporting many endangered flora and fauna. Imminent threats to habitats: None foreseen. Changes since last year: none. Papilio glaucus 2(S), P. cresphontes 1(S), P. troilus 6(S), P. palamedes 55(S), Eurema nicippe 10(S), Phoebis sennae eubule 6(S), P. statira 1(N), Appias drusillus 1(N), Nathalis iole 7(S), Euptychia areolata 2(N), Heliconius charitonius tuckeri 21 (S), Dryas julia cillene 1(N), Phyciodes tharos 150(S), P. phaon 2(N), Precis coenia 9(N), Anartia jatrophae guantanamo 75(S), Martesia tetius thetys 12(S), Limenitis archippus 200 (S), Vanessa atalanta 1(S), Danaus gilippus berenice 56(S), D. plexippus 1(S), Pyrgus syrichtus 24(S), Erynnis horatius 5(N), E. zarucco 4(N), Problema byssus 8(N), Epargyreus clarus 6(S), Ancyloxypha numitor 1(N), Leptotes cassius theonus 1(N), Panoquina panoquinoides 2(N), Hesperia leonardus 1(N), Lerodea eufala 2(N). Total 31 spp., about 675 individuals.

Lower East Pearl River, MS-LA. 30°21'N, 89°40'W. See 1977 report for description. 7 July 1979; 0930-1600. A.M. Mostly clear. P.M. Mostly clear, partly cloudy. 24-34°C, wind SE 4-10 km/hr. Two observers in 1-2 parties. Total party-hours 7.5 (2 on foot, 5.5 by car); total party-miles 149 (4 on foot, 145 by car). Observers: Frank Ehret, Jr., Lance Ehret, Frank P. Fischer, Jr. (2720 Octavia St., New Orleans, LA 70115), Steven Fischer. Conservation status: not mentioned. Papilio cresphontes 2(S), P. glaucus 3(S), P. palamedes 3(S), Phoebis sennae 1(S), Euptychia sosybia 2(S), Vanessa cardui 2(S), Precis coenia 4(C,S), Limenitis astyanax 6(S), Epargyreus clarus 2(S), Hylephila phyleus 8(C,S), Polites vibex 1 (C). Total 11 spp., about 34 individuals.

ZONE VII: NORTHEAST
(Massachusetts, Connecticut, Maryland, Pennsylvania, New York, New Jersey)

Calvert County, MD. 35°37'N, 76°39'W, see 1976 report for further description. 7 July 1979; 0900-1655. A. M.: Clear, partly cloudy. P.M.: Clear. 21-27°C, wind NW, 3-11 km/hr. Three observers in two parties. Total party-hours 14 (4 on foot, 10 by car); total party-miles 82(7 on foot, 75 by car). Observers: Michael Bentzien, John H. Fales (2809 Ridge Rd., Neeld Estate, Huntingtown, MD 20639), Paul A. Opler. Conservation status: Uses of land, Uniqueness of habitats, Imminent threats to habitats: none noted. Changes since last year: certain wooded areas were logged. Papilio polyxenes asterius 3, P. glaucus 40, P. troilus 14, Graphium marcellus 27, Pieris protodice 1, P. rapae 121, Colias eurytheme 21, C. philodice 18, Callophrys gryneus 3, Strymon melinus humuli 9, Lycaena phlaeas americana 3, Everes comyntas 29, Celastrina argiolus pseudargiolus 4, Euptychia cymela 14, Asterocampa celtis 1, A. clyton 1, Limenitis astyanax 2, L. archippus 9, Vanessa atalanta rubria 3, V. virginiensis 6, Junonia coenia 19, Polygonia interrogationis 2, P. comma 4, Phyciodes tharos 88, Speyeria cybele 30, Danaus plexippus 20, Euphyes vestris metacomet 1, Poanes viator 7, Atalopedes campestris 7, Pompeius verna verna 1, Ancyloxypha numitor 2, Pholisora catullus 3, Erynnis horatius 5, Staphylus hayhurstii 1, Thorybes bathyllus 1, Epargyreus clarus clarus 101. Total 36 spp., about 621 individuals. Larvae seen: L. astyanax 1 (on Prunus serotina), V. atalanta 2 (on False nettle).

Greenbrook Sanctuary, Alpine, NJ. Includes towns of Alpine and Tenafly (eastern-most sections of each). Elev. 93-140 m. Habitat coverage: 65% mixed oak forest (red-white-black-chestnut oak), 20% lowland forest (red maple, sweet gum, spicebush), 15% grassy clearings, trail borders and edges of 5 acre pond. 7 July 1979; 1000-1530. Clear, 20-25°C, wind variable, 0-8 km/hr. Four observers in 1 party. Total party-hours 4 (on foot); total party-miles 3 (on foot). Observers: Dianne Engleke, Max and Nellie Larsen, John Serrao (311 Hudson Ave., Tenafly, NJ 07670). Conservation status: Uses of land: private maintained nature sanctuary - nature study, hiking, photography - no camping or swimming. Uniqueness of habitats: Small, man-made sphagnum bog (created 1948). Imminent threats to habitats: None. Changes since last year: Grassy 1 acre clearing was created last year. Other small clearings created in past years are now lush with wildflowers and grasses and are being maintained as open habitats. Papilio glaucus 4(S), P. troilus 1(S), Pieris rapae 28(S), Lycaena phlaeas americana 1(S), Satyrium edwardsii 5(N), S. falacer 5(S), S. liparops 1(S), Euptychia cymela 42(S), Polygonia interrogationis 5(S), Nymphalis antiopa 32(S), Vanessa atalanta 11(S), V. virginiensis 2(S), Junonia coenia 1(S), Asterocampa celtis 3(S), Epargyreus clarus 3(S). Total 16 spp., about 137 individuals. Larvae seen: Vanessa atalanta 50 (on False Nettle), Papilio glaucus 2 (chrysalids).

Lower Bucks County, PA. 40°2'N, 75° W. See earlier reports for further description. Habitat coverage: swampy, residential, park meadows. 15 July 1979; 1030-1500. Hazy, partly cloudy, 31-33°C. Wind E, 8 km/hr. Two observers in 1 party. Total party-hours 8 (on foot); total party-miles: 3 (by car). Observers: Wynne Epstein, Frances Naas (9 Harding Ave., Feasterville, PA 19047). Conservation of land: Uses of land: One park meadow of flowers and grasses overgrown with grapevine. No lepidoptera this year. Uniqueness of habitats and Imminent threats to habitat: none noted. Changes since last year: Field where Speyeria cybele found for past 2 years is now under a boating lake. Only spot we've ever found S. cybele. Papilio polyxenes asterius 2(S), P. troilus 1(S), P. glaucus 3(S), Colias philodice 7(S), Pieris rapae 35(S), Everes comyntas 2(N), Vanessa atalanta 2(S), Speyeria atlantis 15(N), Phyciodes tharos 4(N), Danaus plexippus 5(S), Epargyreus clarus 2(N). Total 11 spp., about 75 individuals.

Pool Wildlife Sanctuary, PA. 40°32.5'N, 75°30.5'W, center Pool Wildlife Sanctuary, 601 Orchid Pl., Emmaus, PA 18049, includes area within Route 29 to the W, Little Lehigh Creek to the S and E, Lehigh Country Club to the N. Elev. 97-121 m. Habitat coverage: 60% meadow, 20% edge, 15% deciduous woodland, 5% river. 23 June 1979; 1000-1400. Clear, 25-28°C, wind NW, 5-9 km/hr. Thirty-six observers in 18-2 parties. Total party-hours 2(on foot); total party-miles 1/2 (on foot). Observers: (Leaders, identifiers, compilers): Marcia Eddy, Kenneth Friedman, Bernard Kita (Jos. Ayers, Inc., Bethelem, PA) Philip Klotz, Mary Ann Tretter. Conservation status: Uses of land: sanctuary, wildlife habitat, environmental education. Uniqueness of habitats: None. Imminent threats to habitats: succession, run off (river). Changes since last year: N/A. Pieris rapae 174 (S), Eurema sp. 4(S,N), Speyeria sp. 7(S), Vanessa sp. 1(S), Nymphalis antiopa 1(S), Ancyloxypha numitor 8(S,N), Epargyreus clarus 1(S). Total 7 spp., about 205 individuals.

Union City, PA. 41°53'N, 79°53'W, center foot of Oak Hill at Jct Wheelertown Rd. and Rt. 92. See earlier reports for description. 7 July 1979; 1000-1700. A.M.: Clear. P.M.: Mostly clear. 16-19°C, wind NW to 8 km/hr. Two observers in 1 party. Total party-hours 7 (6 on foot, 1 by car); total party-miles 7 (3 on foot, 4 by car). Observers: Gerald M. McWilliams (1 O'Dell St., Union City, PA 16438), Jim Flynn. Conservation status: Uses of land, Uniqueness of habitats, Imminent threats to habitats: same. Changes since last year: No significant change. Papilio glaucus 2 (S), Colias philodice 3(S), C. eurytheme 1(S), Pieris rapae 95(S), Harkenclenus titus 7(S), Satyrium acadica 3(S), Lycaena phlaeas americana 1(S), Celastrina argiolus pseudargiolus 4(S), Limenitis archippus 2(S), Polygonia comma 1(C), Vanessa atalanta 6(S), Nymphalis milberti 2(C), N. antiopa 1(S), Speyeria cybele 14(S), S. atlantis 1(C), Boloria toddi 30(S), Danaus plexippus 12(S), Euptychia cymela 2(S), Cercyomis pegala alope 1(S), Lethe eurydice 1(C), Atrytone ruricola 2(S), Wallengrenia egeremet 1(N), Epargyreus clarus 3(S), Polites peckius 11(S), P. themistocles 2(N), Poanes hobomok 1(S), Thymelicus lineola 700+(S), Polites mystic 4(S). Total 28 spp., about 923 individuals.

Jamaica Bay Wildlife Refuge, NY. 73°50'N, 40°37'W, center Jamaica Bay Wildlife Refuge. Elev. 0-10 m. 15 July 1979; 1030-1500. Partly cloudy, 30-32°C, wind S, 6 mph. Four observers in 1 party. Total party-hours 4:20 (4 on foot, 20 min. by car); total party-miles 4 (2 by car, 2 by foot). Observers: Jim Ash, David Brandt (105 Ashland Place, Brooklyn, NYC, NY 11201), Donald Riepe, Steve Swinburne. Conservation status: Uses of land: Wildlife refuge. Uniqueness of habitats: marsh, field, dune. Imminent threats to habitats: none. Changes since last year: none noted. Papilio glaucus 1(S), Pieris rapae 100(N,S), Colias philodice 9(N,S), Polygonia interrogationis 1(N), Nymphalis antiopa 4(S), Vanessa cardui 3 (N), Limenitis archippus 2(N,S), Danaus plexippus 2(S), Polites peckius 6(N). Total 9 spp., about 130 individuals.

Greenwich Audubon Center, CT. 41°04'N, 73°41'W, see earlier reports for description. 30 June 1979; 0900-1800. A.M.: Mostly cloudy. P.M.: Partly cloudy, moderate rain. Wind SW, 8-16 km/hr. Eleven observers in 1-7 parties. Total party-hours 7-1/2 (on foot); total party-miles 5 (on foot). Observers: Doris Bora, Tom Burke, Mrs. Gibson, Sheila McMahon, Beth Russell, Paul Russell, Sandy Russell, Alice Smith, Sue Stepers, Robin Strain (Audubon Center in Greenwich, 613 Riversville Rd., Greenwich, CT 06830) Joe Zeranski. Conservation status: Nothing noted. Papilio glaucus 2(S), P. troilus 1(S), Pieris rapae 131(S), Colias philodice 16(S), Strymon liparops 2(N,S), Calanus falacer 5 (N,S), Strymon acadica 79(N,S), Lycaena phlaeas americana 2(S), Celastrina argiolus pseudargiolus 1(S), Harkenclenus titus titus 16(N), Euptychia cymela 29(S), Cercyonis pegala 3(S), Lethe (?) sp. 2(S), Speyeria cybele 57(S), Boloria sp. 5(N), Melitaea nycteis 12 (S,N), Phyciodes tharos 3(N), Polygonia interrogationis 2(S), Vanessa atalanta 2(S), V. virginiensis 1(S), Nymphalis j-album 1(S), N. antiopa 39(S), Junonia coenia 3(N), Limenitis archippus 4(S), Danaus plexippus 1(S), Epargyreus clarus 11(S), Achalarus lyciades 7 (S), Ancyloxypha numitor 151(S), Polites verna 20(N,S), Poanes hobomok 2(N), Erynnis sp. (?) 8 (N,S). Total 30 spp., about 954 individuals. 38 spp. of moths were also listed, including 3 larvae or cocoons.

Eliot Pratt Educ. Center, CT. 41°30'N, 73°28'W, center Eliot Pratt Educ. Center, New Milford, CT, includes dry meadow, vegetable garden, and farm land, brookside meadow, wooded area, mowed meadow, residential. Elev. 100-140 m. Habitat coverage: dry meadow, grasses-wild flowers-clover. Low meadow, hedgerow-sycamore, willow, ash, black walnut, cherry. Wooded, maple, birch, shrubby, spice bush, etc. 1 July 1979; 1000-1300. Partly cloudy, 21-24°C, wind SW, 0-6 km/hr. Six observers in 1 party. Total party-hours 3 (on foot). Total party miles 1.5 (on foot). Observers: Sharon Brown, Joan DeWind (Sherman, CT 06784), Larry Gall, Beatrice Prouty, Ellen Prouty, Tom Prouty. Conservation status: Uses of land: Land that of the Education Center, a nature demonstration or education center. Some land used for community garden. Two brookside fields had been mowed. Uniqueness of habitat: not stated. Imminent threats to habitats: Fields mowed-see above. Suggested they hold off mowing next year until after the butterfly walk, and preferably only mow when fields are threatened with heavy brush. Changes since last year: see above-mowing. Colias philodice 4(S), Pieris rapae 16(S), Lycaena phlaeas americana 2(C,S), Strymon falacer 2(S), Euptychia cymela 3 (C,S), Cercyonis pegala alope 5(N,S), Speyeria cybele 13 (N,S), Boloria toddi ammiralis 11(N,S), Phyciodes tharos 2(C,S), Polygonia comma 1(S), Thorybes pylades 1(N), Ancyloxipha numitor 12(S,N). Total 12 spp., about 72 individuals. Larvae seen: Vanessa atalanta 5 (on stinging nettle), Papilio polyxenes asterias 2 (on parsley), Pieris rapae 10(C) (on cabbage).

Sherman, CT. 41°51'N, 73°30'W, center Xerces Society, Briggs Hill, includes DeWind fields, Graeter-Beardslee gardens, Town Meadows, brookside wet meadow, hillside dry meadows, and low brush beginning of woods. Elev. 72-400 m. Habitat coverage: Unmowed fields, much milkweed and assorted wildflowers, G-B flower gardens, residential, town garage-gravel heaps and swamp w. garbage fill, town meadows, wet and dry meadows. 10 July 1979; 1000-1330. Hazy, 21-26°C, wind SW, 0-12 km/hr. Five observers in 1 party. Total party-hours 3.5 (3.25 on foot, 1/4 by car); total party miles 5 (1.75 on foot, 3.25 by car). Observers: Jean Breen, Mariam Chapman, Joan DeWind (Sherman, CT 06784), Daniele Endress, Debbie Hopkins. Conservation status: Uses of land: DeWind fields-preserved for butterfly counting. Graeter-Beardslee's garden-many nectar producing flowers. Town garage and sand dump, swamp area here being ruined, town meadows-o.k. Uniqueness of habitats: Only DeWind's acid pond. Imminent threats to habitats: Town garage area being filled, spoils that small particular swampy area, but not the entire swampy land. Changes since last year: Fill at town garage. Papilio glaucus 3(S), P. troilus 1(S), Colias philodice 3(N,S), Colias eurytheme 1(N), Pieris rapae 6(N,S), Strymon falacer 4(S), Everes comyntas 2(S), Euptychia cymele 2(S), Cercyonis pegala alope 11(N,S), Speyeria cybele 9(N,S), S. aphrodite 2 (N,S), Boloria toddi ammiralis 6(N,S), Phyciodes tharos 1(S), Nymphalis antiopa 2(S), Vanessa atalanta 4(C,N,S), Danaus plexippus 2(S), Epargyreus clarus 2(S), Thorybes pylades 1 (N), Ancyloxypha numitor 9(C,S). Total 19 spp., about 71 individuals. Vanessa virginiensis 6(C) (on Pearly everlasting), Danaus plexippus 2 and 5 eggs (on Asclepias syriaca), Polygonia comma 1 (on Urtica), Vanessa atalanta 2 (on Urtica).

Sherman, CT (Part II, North Sherman) 41°51'N, 73°30'W, center Xerces Society, Briggs Hill, Sherman, includes Carlson property, gravel pits no longer being mined, dry meadow, field edges of hard woods, shrubs, and riverside wet meadows. Elev. 72-400 m. Habitat coverage: gravel pits-grasses, many wildflowers. Dry fields-grasses, beginning shrubs, brambles, etc. 13 July 1979; 1015-1345. Hazy, 25-34°C, wind SE, 0-14 km/hr. Four observers in 1-2 parties. Total party-hours 3-1/2 (3 on foot, 1/2 by car); total party-miles 11 (2 on foot, 9 by car). Observers: Miriam Chapman, Joan DeWind (Sherman, CT 06784), Regina Ryan Deutschman, Eleanor Fischer. Conservation status: Uses of land: Was grazing and farm land, one-half was then gravel mined, top soil removed, now one of the best wildflower sites in Sherman, now some fields planted with rye or oats. Grazing land is becoming overgrown. Uniqueness of habitats: Contains two of the largest cedars in Connecticut and two very large oaks. Imminent threats to habitats: Land has just been sold for development over the efforts of the local Land Trust and the beginning interest of the State Department of Environmental Protection. Changes since last year: Increasing number of wildflowers and increasing scrubby growth in the grazed fields. Colias philodice 10(S), Pieris rapae 11(S), Everes comyntas 1(S), Euptychia cymela 1(S), Cercyonis pegala alope 2(S), Speyeria cybele 7(S), Boloria toddi ammiralis 2(S), Phyciodes tharos 5(S), Nymphalis antiopa 5(S), Vanessa atalanta 2(S), V. virginiensis 1(S), Polygonia comma 2(S), Epargyreus clarus 2(S), Ancyloxipha numitor 3(S), Amblyscirtes vialis 3(S). Total 15 spp., (2 additional forms - hybrid Colias), about 57 individuals. Larvae seen: Polygonia comma 2 (on Urtica).

White Memorial Conservation Ctr. (changed name, was Litchfield Nature Center), CT. 41°45'N, 73°15'W, center White Mem. Conservation Ctr. and Museum, includes White Flower Farm, nursery and display, perennial growing area, T.J. Camp field, acid bog around RR tracks. Habitat coverage: Woods and farm, roads. Commercial nursery 50%. Wet and dry meadow, wild flowers and grasses, surrounded by hardwoods, alder, willow 25%; acid bog, scrubby brush, marsh shrubs, flowers and grasses, 25%. 21 July 1979. 1030-1430. A.M.: Hazy, cloudy. P.M.: Hazy, some fog, partly cloudy. 23-28°C. Winds, S, SW, 0-3 km/hr. Eleven observers in 1-3 parties. Total party-hours 4 (3-1/2 on foot, 1/2 by car); total party-miles 4 (1-1/2 on foot, 2-1/2 by car). Observers: Helene Dautrich, Joan DeWind (Briggs Hill, Sherman, CT 06784), Tammy Goggin, Carol Gregory, Gladys Gregory, Jay Gregory, Alfred Uhry, Jolly Uhry, Nell Uhry, Judy Waldman, Robert Waldman. Conservation status: Uses of land: Nursery uses for 50%, flower growing, some fallow fields, other fields in grass and wildflowers. Damp field now planted with tamarack and pine. Swampy area half under water, was old RR tracks. Uniqueness of habitats: Acid swamp w. RR tracks. Imminent threats to habitats: T.J. Camp, wet or dama field now planted. RR tracks, acid bog, scrubby brush is now 3-5 feet, may overcome. Changes since last year: Listed above, under threats. Papilio glaucus 2(S), P. troilus 1(S?), Colias eurytheme 1(S), Colias philodice 2(S,N), C. philodice-hybrid 1(C), Pieris rapae 15 (S,N,C), Lycaena phlaeas americana 1(N), Strymon falacer 1(S), Everes comyntas 1(S), Cercyonis pegala alope 45(S,N), C. pegala nephele 1(C), Danaus plexippus 7(S), Speyeria cybele 8(S,N,C), Phyciodes tharos 5(C,S), Nymphalis antiopa 1(S), Limenitis archippus 2(S), L. astyanax 3(S,N), Epargyreus clarus 4(S,N), Thorybes pylades 2(N,C), Ancyloxypha numitor 4(C,S). Total 18 spp., about 102 individuals. Larvae seen: Vanessa virginiensis 2 (on Cultivated everlasting).

Woodshole, MA. 41°31.4'N, 70°40.4'W, center at Woodshole, includes Falmouth hospital area, Beebe Woods Conservation area, Frances Crane management area, Hatchville Cranberry bog and pasture; and Marvin Gardens Development. 9 July 1979; 0830-1430. 27°C, wind 8-16 km/hr. Two observers in 1 party. Total party-hours 6; total party-miles not stated. Observers: R. L. Edwards (N.O.A.A., Nat'l Marine Fisheries Service, Northeast Fisheries Center, Woodshole, MA 02543), E. H. Edwards. Conservation status: not stated. Papilio glaucus 8, P. troilus 19, Colias philodice 48, Pieris rapae 45, Eupsyche m-album 2, Harkenclenus titus 5, Lycaena phlaeas 16, Everes comyntus 10, Euptychia cymela 9, Cercyonis pegala 25, Polygonia interrogationis 2, Nymphalis antiopa 7, Vanessa atalanta 1, V. cardui 8, V. virginiensis 1, Limenitis arthemis 1, L. archippus 1, Danaus plexippus 24, Epargyreus clarus 25, Thorbyes bathyllus 5, Polites mystic 1, Atrytone delaware 18, Euphyes vestris 1, Pompeius verna 3, Ancyloxypha numitor 5, Hesperia attalus 32. Total 26 spp., about 322 individuals.

Southern New Haven County, CT. 41°20'N, 72°58'W, center Jct Routes 10 and 15 in Hamden. See previous reports for further description. 6-7 July 1979; 1445 (6 July) - 1305 (7 July). Clear, 20-26°C, wind NW, 0-15 km/hr. Two observers in 1 party. Total party-hours 4 (2.5 on foot, 1.5 by car); total party miles 37(2 on foot, 35 by car). Observers: Larry Gall (Dept. of Biology, Yale Univ., New Haven, CT 06520) and Dale Schweitzer. Papilio glaucus 1(S), Colias philodice 18(S), C. eurytheme 1(S), Pieris rapae 40(S), Satyrium falacer 42 (S), S. edwardsii 12(N), S. liparops 7(N), S. acadica 70+(N), Harkenclenus titus 5(N), Lycaena phlaeas 3(S), Celastrina argiolus 1(S), Everes comyntas 10(S), Lethe anthedon 2(S), L. appalachia 9(C), Euptychia cymela 24(N), Cercyonis pegala 6(S), Chlosyne nycteis 13(N), Phyciodes tharos 3(N), Speyeria cybele 16(C), Boloria bellona 3(S), Euphydryas phaeton 10(N), Polygonia comma 2(S), P. interrogationis 1(S), Nymphalis antiopa 29(S), Vanessa cardui 1(S), V. virginiensis 1(S), Limenitis archippus 1(S), L. arthemis-astyanax hybrid 1(C), Asterocampa celtis 5(N), Danaus plexippus 1(S), Epargyreus clarus 3(S), Thorybes bathyllus 5(C), Achalarus lyciades 6 (C), Ancyloxypha numitor 2(S), Thymelicus lineola 24(S), Pompeius verna 6(C), Polites coras 2(N), Wallengrenia otho 16(C), Poanes hobomok 1(N), P. massasoit 4(N), Atrytone logan 10(N), Euphyes conspicua 17(N). Total 42 spp., about 434+ individuals. Larvae seen: Danaus plexippus 1 (on Asclepias syriaca).

ZONE IX: PACIFIC ISLANDS
(Hawaii)

Honolulu, HI. 21°22'N, 157°48'W, center just ENE of Nuuanu Pali, Oahu Island, includes most of urban Honolulu and windward and leeward slopes of SE end of Koolau Range, bounded by Aiea, Salt Lake, Diamond Head, Waimanalo, Mokapu, and Kahaluu. Elev. 0-960 m. Habitat coverage: 49% lowland koa woodland-mesic forest, 21% mesic- to rain forest, 18% dry- to mesic forest, 6% urban lowlands, 5% suburban anthropogenic savannah and mesic forest. 14 July 1979; 0830-1700. A.M.: Mostly clear, some fog, partly cloudy, intermittent light drizzle. P.M.: some fog, partly cloudy, intermittent moderate drizzle and rain. 25-33°C, wind 0-26 km/hr. Two observers in 2 parties. Total party-hours 4:36 (by car); total party-km 4 (on foot). Observers: F. G. Howarth, G. A. Samuelson (Bishop Museum, 1355 Kalihi Street, Honolulu, HI 96819). Conservation status: Uses of land: see 1977 report. Uniqueness of habitat: see 1977 report. Imminent threats to habitats: (see 1977 count) Continued urbanization, including extensive bulldozing inside Kahaluu Forest Reserve which has koa forests at 100m; plant pest Clidemia hirta continues to spread in forest environments; Wedelia trilobata spreading into forests at lower elevations. Changes since last year: (since 1977) Vaga blackburni (Tuely) population down about 50%, Vanessa tameamea Esch. about the same. A newly adventive lycaenid, Brephidium exilis Boisd. is possibly established on Oahu (Pearl Harbor), but was not seen by us. Papilio xuthus 5(S), Pieris rapae 5(S), Danaus plexippus 2(S), Vanessa tameamea 3(S), Agraulis vanillae 28(S), Lampides boeticus 3(N,S), Vaga blackburni 55(N.S), Thmolus echion 3(N), Hylephila phyleus 4(S). Total 9 spp., about 108 individuals.

COUNT RESULTS ARE REPORTED IN THE FOLLOWING ORDER OF DATA:

(1) Name of Count area, county and state.
(2) Precise (longitude, latitude) and descriptive location of count center. Count area is a circle with a 15 miles diameter.
(3) Sites included within the count circle.
(4) Types and amounts of each habitat type within count circle.
(5) Date and time of butterfly count.
(6) Climatic conditions
(7) Number of participants
(8) Total time spent by count party on car or foot
(9) Total distance (miles) covered by count party on car or by foot.
(10) Names of participants; address for compiler.
(11) Conservation status of count area habitats.
(12) Changes in conservation status since last count.
(13) Recorded butterfly species.
Key to Abundance Abbreviations:
(A) Numbers refer to numbers of individuals seen.
(B) Method of identification: N - identified in the net; S - sighted; C - collected (vouchers)

THE FOURTH OF JULY BUTTERFLY COUNT IS ORGANIZED AND SPONSORED BY THE XERCES SOCIETY, AN INTERNATIONAL ORGANIZATION DEVOTED TO HABITAT PROTECTION FOR RARE & ENDANGERED TERRESTRIAL ARTHROPODS (ESPECIALLY BUTTERFLIES) AND TO ENHANCING AN APPRECIATION OF THE BENEFICIAL ROLES INSECTS PLAY IN NATURAL ECOSYSTEMS. FOR FURTHER INFORMATION ON THE FOURTH OF JULY BUTTERFLY COUNT, PLEASE CONTACT: Ira Heller, Department of Biology, Tufts University, Medford, Massachusetts, 02155, USA.

FOR FURTHER INFORMATION ON THE SOCIETY, PLEASE CONTACT: Terry Clifford, Secretary, Department of Zoology & Physiology, University of Wyoming, Laramie, Wyoming 82071, USA.

PUBLISHED BY THE XERCES SOCIETY AT BERKELEY, CALIFORNIA
AUGUST 1980

ATALA

Volume 8, No. 1 1980(82)

Eco-Geography of Washington Butterflies

THE XERCES SOCIETY

An international, non-profit organization dedicated to the conservation of terrestrial arthropods and their habitats. Named for the extinct Xerces Blue Butterfly, *Glaucopsyche xerces* (Boisduval). Founded on 9 December 1971.

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Published at Los Angeles, California, USA, in May 1982 by the Xerces Society in cooperation with The Lepidoptera Research Foundation.

ATALA

JOURNAL OF THE XERCES SOCIETY

Volume 8 | 1980(82) | Number 1

Butterfly Eco-Geography and Biological Conservation in Washington[1]

Robert Michael Pyle[2]

Conservation Monitoring Centre of IUCN, 219c Huntingdon Road
Cambridge, England CB3 ODL

Abstract

About 10,000 distributional records for the 138 species of Washington State butterflies were accumulated and plotted on a new set of naturally derived subdivisions of the Gould Geo-Code units for Washington. Certain biogeographical patterns among the Washington rhopalocerine fauna stand out. These are related to the origins of the fauna and the subsequent effects of human disturbance. The superimposed range margins of 116 species suggest natural biotic regions, or butterfly provinces, within Washington. The major provinces were delimited and their faunal resemblances compared in order to test their biogeographical validity. The 16 units were then measured against the distribution and acreage of nature reserves throughout the state. The butterfly provinces vary widely in the proportion of each which is managed primarily for purposes of nature conservation. A general ordering of state-wide reserve priorities was developed from this comparison.

Each of the butterfly provinces is discussed with regard to specific lepidopteran populations which most warrant conservation attention. In this way, both the regional and site-specific management alternatives are taken into account in developing overall Lepidoptera conservation guidelines for Washington. Butterflies serve well as indices of biotic regionality. They may also be excellent indicators of ecological uniqueness of sites. Examples of butterflies as eco-indicators are discussed in connection with conservation of the habitats which they characterize. Newly discovered populations of butterflies in Washington, which are highly disjunct and/or taxonomically distinct, provide some of the best cases of butterflies as indicators and as taxa threatened with extinction from natural or human factors.

Introduction

The conservation of natural ecosystems as a land management objective requires an operational plan in order to be fully effective. Since wildlife and other natural features are not randomly distributed over the landscape, but are controlled by ecological limitations and evolutionary history (Darlington, 1957), random placement of nature reserves may not result in adequate biological conservation. Habitat reservation ordinarily has been accomplished in a spot-to-spot fashion, whereby tracts of land were set aside as they became threatened or available. Today, an exceedingly complex matrix of nature reserves exists across North America and other continents. That this system is inadequate is evident to any biologist involved in field studies on the progressively shrinking habitat base. Yet as available funds and opportunities for land conservation diminish, choices become critical and an ordering system for nature reserve priorities grows more essential.

Biologists agree that informed and coordinated efforts toward comprehensive biotic conservation should be accelerated. Sullivan and Shaffer (1975) asked what assemblage of wildlife would constitute a reasonable "megazoo." Others have tried to answer that question. A National System of Ecological Preserves (or Natural Areas) was proposed by two recent colloquia, one sponsored by the American Institute of Biological Sciences (Lemon, 1974), the other by The Nature Conservancy (Humke, *et al.*, 1975). While concluding that preservation of natural diversity should be a congressional imperative, the Conservancy also addressed the problem of comprehensive ecological pre-

[1]Adapted from Part I of *The Eco-Geographic Basis for Lepidoptera Conservation*, Pyle, R. M. 1976. Ph.D. Thesis, Yale University. 369 pp.

[2]Permanent Address: Swede Park, Loop Road Box 123, Gray's River, WA 98621 USA

servation on the state level, through its State Natural Heritage Program (Moyseenko, 1974). Another contributory system is that of the Federal Research Natural Areas, which various federal agencies designate on the public lands (Franklin and Trappe, 1968). Each of these approaches aims to build a set of reserves which is representative of every biotic community present in the area (nation, state, federal land network) under consideration.

The practical evaluation of individual sites for inclusion in reserve status has also attracted attention. Goldsmith (1975) developed and field-tested an index which could be used by British county planning authorities to rank criteria of ecological resources such as extent, naturalness, richness, and diversity. A somewhat similar method was developed for use by naturalists in Texas, whereby priority for acquisition can be distinguished (Gehlbach, 1975). This method gave weighted values to the criteria of climax condition, educational suitability, species significance, community representation, and human impact.

Each paper cited above provided a means of establishing conservation priorities; together, they evidenced the need for deciding which management alternatives will result in the best ecosystem preservation results for the least cost and labor. While research such as Goldsmith's and Gehlbach's deals with local site selection, the "megazoo" concept concerns a reserve network based on ecological inclusiveness, such as all three systems mentioned are trying to achieve. Both of these levels are necessary for an optimal approach to the problem of nature conservation.

There is a step missed here, however. On the regional level, how can authorities and conservationists decide where they should concentrate their efforts to achieve most efficiently those results which are ecologically most effective? As persons concerned with biological conservation move from the constant brush-fire approach toward that of longer range planning, they need to know where to concentrate their resources first. One way would be by comparing the area and location of existing reserves within areas of ecological or biogeographical distinctness. Simply, the areas with least land preserved should be concentrated upon prior to other areas of similar biological distinctness, which have more reserves.

Just as questions of site selection have arisen, taxonomic prejudice, among wildlife has begun to decline among conservationists. Faunal groups previously ignored in favor of birds and mammals routinely receive conservation attention today. Pyle (1976b) investigated in detail the past and current situation in regard to conservation of a particular group, the insect order Lepidoptera. The dramatic decline of natural habitats for butterflies and moths, and the concomitant need to preserve such habitats in order to prevent extinction of lepidopteran populations, has been discussed by Sieker (1967), Pyle (1976c), and Heath (1981).

This paper addresses both the problems of Lepidoptera conservation and management and of developing a priority ranking method for regional nature reserves. It poses three questions: (1) How best can applied insect biogeography be employed as a basis for new planning in regional biological conservation? (2) How well do butterflies serve as specific site indicators, for ecological characterization of conservation importance? (3) Might greater attention to the Lepidoptera resource have broad conservation implications?

As a paradigm for butterfly conservation anywhere, nature reservation needs for Washington State will be judged, based on the results of faunistic research which will be described below.

Methods

Biogeographical bases for conservation planning. Modern theory of dynamic animal and plant distribution has begun to be incorporated into actual and potential nature reservation programs (Diamond, 1974; Willis, 1974; Wilcox, 1980). Examining management questions by the application of the equilibrium theory of island biogeography (MacArthur and Wilson, 1967) may have dramatic results for reserves in regions with fragmented (insularized) habitats. Of greater immediacy, however, is the process of selecting the reserve, which may then undergo scientific management. Of the two basic approaches which may be applied, one is ecological and may be called community-oriented. The studies of Goldsmith and Gehlbach cited above fall into this category. This sort of site-criteria measurement is biogeographical in the sense that microdistributions and range parameters come into the evaluation. However, such site-specific gauging methods use ecological parameters rather than area-related distribution measures, and therefore they still fall rather far along the continuum toward community-based reserve site selection. Once a specific vicinity has been identified as having reserve value, systems of classifying habitats, such as that developed by Elton and Miller (1954), can be most useful in determining whether the place should be selected as a reserve, and, if so, what sort of management regime might be optimal for it.

For the conservation biologist faced with a large landscape to interpret, with numerous possibilities for worthy reserves apparent, some other, truly biogeographical tool is wanted which can aide him or her in selecting the most efficient way to proceed. Biotic provinces, which may be compared against extant reserves, may furnish a solution for this purpose. Dasmann's work on classifying natural regions for purposes of conservation on a world basis (1973; IUCN, 1974) is the best example of biotic provinces being applied directly to conservation evaluation. Dasmann was able to tabulate the national parks and equivalent reserves within each biotic province of the world, thereby illustrating global gaps in nature conservation.

Classifying biotic provinces. The classification of portions of the earth's surface into discrete units based on observable differences has long been a central concern of biogeographers. Wallace (1876) established a set of world faunal realms still much in use. Subsequently, botanists and zoologists attempting to sub-classify continental and island areas have developed various schemes to do so. Dice (1943) developed the most detailed North American biogeographical subdivision to date. Dice felt that a biotic province "may best be conceived of as a considerable geographical area sufficiently uniform to permit the development of characteristic types of ecologic associations." Employing a broad base of ecologic and physiographic information, Dice erected a set of biotic provinces on a fairly gross scale which delineated regions of organismal affinity. Later workers mapped the continent with their own taxonomic groups in mind as primary determinants of this affinity. Considering plants, Kuechler (1973) attempted ecological regionalization through the mapping of potential natural vegetation. Hagmeier and Stults (1964) did the same by analyzing mammal distributional patterns, and arrived at a set of provinces not unlike those set forth by Dice. Armstrong (1972) also used mammals, but on a finer scale, delimiting faunal areas of Colorado by subjecting his faunistic data to various kinds of analysis. Many other applications have been made of the biotic province technique, but these examples give a reasonable

cross-section of the field, and they furnish most of the models for the present study.

The usefulness and reality of biotic provinces have been challenged and defended. Peters (1955) concluded that biotic provinces eluded standardization and were not ultimately useful as standardized indices. But Axtell (1962) felt that Peters had too narrowly circumscribed the potential applications of provinces, and felt that they could be exceedingly useful if their limitations were understood along with the expectations one held for them. In view of their inherent usefulness as geographic units of natural derivation, among which conservation parameters can be compared (as in the Dasmann/IUCN studies), I decided to employ a variation on biotic provinces for my purposes.

Insects have not frequently been used as the organismal basis for province development. Butterflies were employed by Wallace, however, in his classical delineation of world faunal realms. For example, Wallace (1880) referred to the remarkable degree of convergence in wing shape demonstrated by Celebesian butterflies of three families as an expression of the biogeographical distinctness of the Celebes. Other butterfly distributions figured in his substantiation of "Wallace's Line." On a North American scale, Van Dyke (1939) attempted to classify zoogeographic areas based on the distribution of beetles. Most faunistic/biogeographical work with insects has been on a regional or local scale. Steyskal (1958) showed how standard faunal lists might be used to clarify the broad geographic affinities of faunas and their host regions, working primarily with ephydrid flies of Michigan and Florida.

Of the many local lists and faunistic studies of butterflies which have been published, relatively few have attempted to analyze the distribution observed with respect to either ecological or geographical patterns. Opler and Langston (1968) studied the butterflies of Contra Costa County, California, and related their distribution to vegetational districts and regional components of Dice's biotic provinces. They did not numerically compare species diversity of butterflies with the accepted regions, nor did they erect special districts based on butterfly distribution on a local basis. Examining isolated components across a larger area, Holland (1974) compared the faunal similarity among six non-contiguous mountain ranges in New Mexico. While he did not employ his data in any biotic province way, his analytic treatment of the relative richness and correlations between faunal areas furnished one kind of basis for characterizing the areas themselves. Another way is to describe "butterfly provinces," analogous to Hagmeier's mammal provinces, based on faunal similarities among different recognizable parts of a region. As a part of earlier descriptive studies of Washington Rhopalocera (Pyle, 1974), I suggested a set of such provinces which were derived intuitively from apparent characteristics of the state fauna. It is these kinds of butterfly provinces, as limited versions of biotic provinces, with which this paper concerns itself.

Previous application of butterfly biogeography to conservation. The best example of applied insect biogeography as a conservation tool comes from the British Biological Records Centre. The Insect Recording Scheme (Heath, 1971a) furnishes a dynamic, visual basis whereby changes of range may be documented and conservation strategies formulated. In a relatively small area such as the British Isles, conservation priorities reveal themselves strikingly on a well mapped grid, without the need for interpretation through comparison between different faunal regions.

By listing butterflies found in certain state parks, Masters (1975) characterized these reserves as reservoirs of diversity in an otherwise depleted landscape. Pyle (1971 and in press) considered the distribution of butterflies along an interurban watercourse, and drew conclusions pertaining to the effects of metropolitan growth as well as to conservation opportunities. Such local surveys, especially when accompanied by information on recent local extinctions, furnish baseline data against which management alternatives can be evaluated. Hartzell (1931) has shown how ecotopographic maps can be applied to economic entomology, and there is no reason why the same sort of technique would not fuction as an aid to rare insect conservation.

As far as I have been able to find, no one has attempted to carry out a Dasmann-type reserves-per-region analysis based on a Holland-type comparison of faunal resemblances among subregional elements of the butterfly fauna. Such an attempt is reported here.

The Hypothesis. Mapping the distribution of Washington State butterflies should enable designation of the major biotic (butterfly) provinces, which may then be scanned for nature reserve representation in order to rank priorities for future diversity conservation efforts. If preservation of a reasonable sampling of the state's overall variety is a desirable goal, then the more neglected provinces should receive special consideration when new nature reserves are anticipated.

Insect mapping methods. Several obvious approaches can be taken for cartographically representing the distribution of organisms. Simple shaded and dot maps, traditionally employed in faunal lists, are not useful for studies in which some sort of quantitative analysis is necessary. Discrete boundaries are required so that area comparisons can be made with precision. One of the most sophisticated and usable insect mapping schemes in operation today is that of the British Biological Records Centre, referred to above. This system employs dot-distribution maps based on a ten-kilometer grid (the British National Grid, which relates to the Universal Trans-Mercator Grid used elsewhere for the European Invertebrate Survey (Heath, 1971b)). Large numbers of field records are transferred to computer discs which then instruct a map printer to type dots in the appropriate grid squares. This kind of system adapts itself well to purposes requiring standardization of the recording unit, and it produces maps which are extremely easy to interpret.

Other kinds of machine mapping methods for insect occurrence have been developed, primarily by economic entomologists. Typical of these is the system described by Brown (1964), for mapping tent caterpillars in Ontario. Computer mapping programs have the advantage of handling many records rapidly and producing map symbols which express several variables.

I had intended to employ a UTM (ten kilometer square) grid system in order to remain compatible with the international insect mapping results of the European Invertebrate Survey (Heath, 1971b). Difficulty was experienced in obtaining reasonably sized maps of Washington bearing the UTM grid designations. Standard USGS topographic maps bear UTM grid ticks in their margins, but no smaller scale maps were available from either USGS or the Army Map Service. An alternative system of world area classification for mapping purposes is the Geo-Code developed by Sidney Gould (1967). This approach utilizes small, relatively uniform political units to make up a numbered set of identifiable place-categories over the globe. In

the United States, the Gould units are counties. It would not, of course, be adequate to use these alone as mapping units, since doing so would not improve on the many other faunal studies which employ the non-biogeographically meaningful unit of the county as the recording unit. However, as Mr. Gould pointed out to me, the Geo-Code units can be further subdivided to reflect various conditions and to suit different needs. It was decided to divide the Geo-Code units for Washington State into smaller areas based on physical features which presumably have distributional importance as barriers or corridors—mountain range crests, major river valleys, and so on. A surprising number of Washington counties were originally defined on the basis of such features, making this system particularly useful here. For this reason, and for the reason that the European Invertebrate Survey employs the Geo-Code as a back-up recording system, it seemed suitable for use in this investigation.

The Geo-Code sub-units which were decided upon for use here are shown by Fig. 1, and are listed below, with brief descriptions of the parameters upon which they were defined. Each county is followed by its Geo-Code designation and in turn by its subdivisions.

Adams County (OKPU): No sub-units. *Asotin County* (OKPZ): No sub-units. *Benton County* (OKPS): (1) south of Yakima River; (2) north of Yakima River. *Chelan County* (OKON): (1) south and west of Wenatchee River; (2) north and east of Wenatchee River. *Clallam County* (OKLM): (1) east of Port Angeles, north of Milwaukee-St. Paul Railroad (incidental, but reasonably clear, definition of the Sequim Rain Shadow area); (2) Port Angeles west to 124° Longitude (see below); north of Highway 101; (3) south of Highway 101, east of 124° Longitude; (4) west of 124° Longitude to Soleduck and Pysht Rivers (the 124° Meridian was chosen to reflect the gradient between the coastal Olympic Rain Forest area and the Olympic Mountains continental area. While an altitudinal contour might have been a more suitable expression of this barrier, it would have been far too convoluted to use for these purposes. Since the 124° line intersects the 1000-foot contour (probably the operant elevation) frequently, it seemed an acceptable border); (5) west of Soleduck and Pysht Rivers to the Pacific Ocean. *Clark County* (OKOX): No sub-units. *Columbia County* (OKPX): No sub-units. *Cowlitz County* (OKOW): (1) east of Cowlitz and Columbia Rivers; .(2) west of Cowlitz and Columbia Rivers. *Douglas County* (OKPO): No sub-units. *Ferry County* (OKPL): No sub-units. *Franklin County* (OKPT): No sub-units. *Garfield* (OKPY): No sub-units. *Grant County* (OKPP): (1) south of Interstate 90; (2) north of Interstate 90 (this artificial barrier furnishes a useful division for this very large county, coincidentally reflecting a more arid northern half and a lake-studded southern half). *Grays Harbor County* (OKLU): (1) south of Chehalis River; (2) north of Chehalis River, east of Humptulips River; (3) west of Humptulips River. *Island County* (OKOK): (1) Whidbey Island; (2) Camano Island. *Jefferson County* (OKLQ): (1) east of Highway 101 (following a sharp contour, the highway effectively defines the coastal lowland strip); (2) west of Highway 101 to 124° "rain forest line;" (3) west of 124° Longitude. *King County* (OKOU): (1) northeast of South Fork of the Skykomish River and Deception Creek; (2) north and east of Snoqualmie River; (3) 122° Longitude east to Snoqualmie River (122° reasonably defines the front foothill barrier between the Cascade Range and the Puget Sound Trough; again, a contour would have been far too complex in its sinuations to employ here); (4) 122° west to Puget Sound; (5) Vashon Island. *Kitsap County* (OKOP): (1) exclusive of Bainbridge Island; (2) Bainbridge Island. *Kittitas County* (OKOR): (1) south and west of Yakima River; (2) north and east of Yakima River. *Klickitat County* (OKOZ): (1) east of Klickitat River; (2) west of Klickitat River. *Lewis County* (OKOS): (1) north of Cowlitz River, west to Skookumchuck River; (2) south of Cowlitz River; (3) west of Cowlitz/Skookumchuck Rivers, east of S. Fork Chehalis River; (4) west of S. Fork Chehalis River. *Lincoln County* (OKPQ): No sub-units. *Mason County* (OKLV): (1) south of S. Fork Skokomish River, west of Highway 101; (2) east of Highway 101; (3) north of S. Fork Skokomish River. *Okanogan County* (OKPK): (1) east of Okanogan River; (2) west of Okanogan River, north and east of Methow River; (3) west and south of Methow River. *Pacific County* (OKLY): (1) east of 124°; (2) west of 124° (Long Beach Peninsula). *Pend Oreille* (OKPN): (1) east of Pend Oreille River; (2) west of Pend Oreille River. *Pierce County* (OKOT): (1) east of 122° Longitude; (2) 122° west to Interstate 5 (in this instance, the freeway defines the topographic barrier between the Puget Lowlands and the Puget Sound coastal zone); (3) west of Interstate 5. *San Juan County* (OKLN): (1) San Juan, Stuart and Speiden Islands; (2) Orcas, Sucia and Waldron Islands; (3) Lopez Island; (4) Shaw Island; (5) Blakely and Decatur Islands. *Skagit County* (OKOM): (1) east of Skagit and Sauk Rivers; (2) 122° Longitude east to Skagit/Sauk Rivers; (3) 122° west to Puget Sound; (4) Guemes and Fidalgo Islands; (5) Cypress and Sinclair Islands. *Skamania County* (OKOY): (1) south and east of Lewis River; (2) north and west of Lewis River. *Snohomish County* (OKOQ): (1) east of Sauk River extended; (2) west of Sauk River, east of 122° Longitude; (3) west of 122° to Puget Sound. *Spokane County* (OKPR): (1) south of Spokane River; (2) north of Spokane River. *Stevens County* (OKPM): (1) north and east of Colville River drainage; (2) south and west of Colville River. *Thurston County* (OKOO): (1) northeast of Deschutes River, south of Interstate 5; (2) southwest of Deschutes River, south of Interstate 5; (3) north of Interstate 5. *Wahkiakum County* (OKLZ): No sub-units. *Walla Walla County* (OKPW): No sub-units. *Whatcom County* (OKOL): (1) east of Skagit River; (2) Skagit River west to 122° west to Puget Sound; (4) Lummi Island; (5) Point Roberts. *Whitman County* (OKPV): (1) south of Palouse River; (2) north of Palouse River. *Yakima County* (OKOV): (1) east of Yakima River; (2) west of Yakima River, south of Tieton River, east of Klickitat River; (3) north of Tieton River, west of Yakima River; (4) west of Klickitat River.

The discrimination sought here was between major, subregional faunas which bear a substantial degree of unity and distinction among themselves, rather than between strictly community-based differences whereby faunas differ from site to site. The butterfly provinces, therefore, would contain a number of communities and life zones and vegetational units; but they would differ on the whole from other provinces in the biogeographical influences which shaped them. Thus the subunit boundaries do not respect local community change so much as broad faunal change gradients; and it is not surprising, therefore, that similar habitats may occur in more than one distinct Geo-Code sub-unit. The butterflies exhibit trends of dispersal and isolation as well as local response to habitats: the former pertain very much to the butterfly provinces, the latter much less so.

It is clear from Fig. 1 that, of the 93 Geo-Code sub-units, many more occur in the humid western part of the state than in the arid eastern portion. This reflects the fact that the

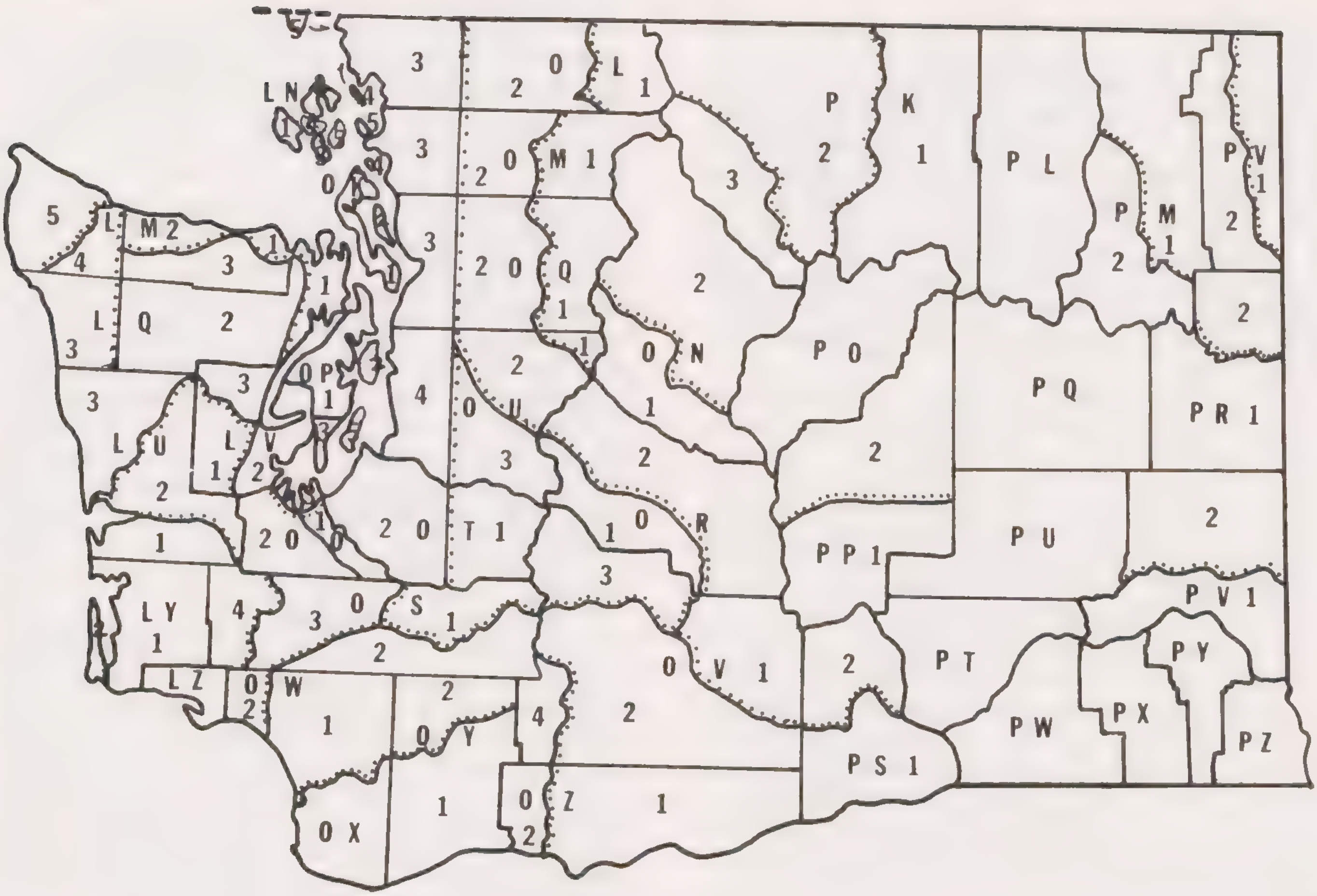


Figure 1. COUNTIES AND GEO-CODE UNITS OF WASHINGTON. The solid lines are the boundaries of the counties and the Geo-Code units, which are the same. The dotted lines represent the Geo-Code sub-unit boundaries, as developed in this study and described in the text.

geography becomes more complicated toward the coast, as well as the presence of distinct island groups in Puget Sound. While it would have been useful to break up more of the large eastern, basin counties such as Lincoln and Adams, logical means of doing so were not apparent to me in scanning their quite homogeneous topography. The system of Geo-Code sub-units finally arrived at, in biogeographic influence if not in size, seems proportional. Certainly it enables a far more precise presentation of species' distributions than the standard unit of the counties themselves (but not as precise as the UTM ten-kilometer grid). This system also permitted calculation of component areas with relative ease, and mitigated the very real problem of precise location of some of the more obscure locality records. Obtaining these records was the next procedure.

Data acquisition. The raw data for this study consisted, in the first instance, of distributional records for butterflies in Washington State. These were obtained from a variety of sources which, while not all-inclusive, did ensure a highly representative sample. A literature search revealed many published records in a number of sources, chief among which was Ben V. Leighton's pioneering check-list for the state (1946). Since errors in this work have been noted (Remington, 1947; Shepard, 1965), no questionable Leighton records were accepted unless the specimens had been seen and verified by myself or other workers whom I consider to be reliable in their judgment. Other helpful papers were those by Newcomer (1962, 1964a, 1964b, 1966a, 1966b), Newcomer and Rogers (1963), Shepard (1962, 1964), Gorelick (1968), Clench (1963), Opler (1968), Opler and Powell (1961), Hopfinger (1956), Bauer (1959), Carney (1961), Burdick (1941, 1942, 1957) and Perkins and Meyer (1973).

The extensive card files of Washington records maintained formerly or presently by J. F. G. Clarke, Jonathan Pelham, and Jonathan Shepard, expert lepidopterists with extensive Northwest experience, were made available to me. A large proportion of the records eventually employed derived from these files. Past and present Washington collectors were canvassed for their field records, and many complied. Extensive correspondence and loan of specimens enabled the verification of unusual or questionable records. I excluded data which could not be verified. Resident and previously resident Washington lepidoptrists from major contributions were received include J. Pelham, J. Shepard, J. F. G. Clarke, D. Frechin, V. Calkins, W. Rogers, P. Handy, S. Vail, D. McCorkle, M. VanBuskirk, R. Miller, R. Woodley, L. Rogers, D. Carney, M. Kimura, R. Nagle and others. E. J. Newcomer sent carded records which augmented his extensive published data for Yakima County.

The single most important block of records originated with the late John C. Hopfinger, whose collecting in Okanogan County spanned half a century. Fortunately, a large body of his material resides in the Peabody Museum of Natural History at

Yale University. Specimen data were augmented by correspondence from J. C. Hopfinger to C. L. Remington; the localities were fixed with greater precision by Remington (1962). Hopfinger's personal collection has been lodged in the United States National Museum, which I visited to obtain additional records of his as well as data from an important set of Washington material accessioned to the Smithsonian Institution by J. F. G. Clarke. Subsequently, the collections of the American Museum of Natural History were checked completely for Washington specimens. Among many others, the only records for the inner Olympic Mountains (collected by Ruth D. Svihla) came from the AMNH. The University of Washington and Washington State University insect collections were personally examined.

First-hand field research substantially augmented the body of data. My own collecting notes go back to 1965 for Washington and the gist of these was previously published (Pyle, 1974). During the summer of 1975, field work was undertaken in Washington. This had been carefully planned to cover undersampled and ambiguous areas, such as several coastal districts and remote montane localities, as well as previously neglected corners of the state. In spite of the unusually rainy summer, many new records (including one state record and several major range extensions) were obtained in this manner.

At the time when incorporation of new material had to be terminated so that the data could be analyzed, approximately 10,000 distributional records of butterflies in Washington State had been secured. This mass of field information covers a century of sampling in every county except one (Wahkiakum County, a small, rainy, thickly forested area on the Columbia River, has apparently produced no butterfly specimens whatever; we spent two days in promising locales, but the rain never ceased).[1] The number of records per species varied from several hundreds each for ubiquitous pierids to two or three each for half a dozen skippers. While it cannot be known exactly what proportion of extant Washington records this sample represents, a reasonable estimate might be one-half to two-thirds. As such, it is probably one of the most complete compilations of state butterfly records, hence adequate for biogeographical analysis on a relatively refined scale.

Including the entire body of data would have the effect of doubling the size of the paper, I suspect. In any case, doing so is not fully warranted: the calculations were based on species' presence within Geo-Code sub-units. The entirety of the data is lodged with the Northwest Lepidoptera Survey, Burke Museum, University of Washington, in the care of J. P. Pelham.

The second group of data which had to be accumulated was that of nature reserve location and acreage. Since the objective was to compile a list of all lands designated for the primary use of nature conservation, it was necessary to query a large number of land-holding or land-managing agencies and organizations within Washington State. Letters requesting lists of all areas managed chiefly for nature conservation went to the National Park Service, the U. S. Forest Service, the Bureau of Land Management, the various Indian Tribes, the Fish and Wildlife Service, the Atomic Energy Commission, major military reservations; Washington State Parks and Recreation Commission, Department of Game, Department of Natural Resources, six state colleges and universities and two private colleges; 39 counties and 35 cities with populations over 10,000; The Nature Conservancy, five chapters of the National Audubon Society, the State Natural Area Preserves Committee, and individuals interested in nature reserves within the state.

The inquiry described the sort of management standard under which lands were considered "nature reserves," and its wording varied according to the kind of agency or organization being addressed. An attempt was made to allow for the variety of land use categories yet to exclude unsuitable or marginal areas. The suitability of replies varied, reflecting the degree of familiarity with land planning practice on the part of the respondent. All federal and state agencies replied, as did nearly all private groups, 13 counties, 15 cities and three Indian Tribal Councils. In tabulating reserved land I also consulted agency publications and maps. The Army Corps of Engineers' *Washington Environmental Atlas* (1974) might have been very useful for this purpose had it included size and ownership data for the many reserves noted in its text and maps. The bulk of the information came from the agencies and organizations themselves. A total of 3,722,650 acres of land managed primarily for habitat conservation in Washington State came under consideration in this study.

It should be noted that these nature reserve totals undoubtedly are too low in some cases. Not all jurisdictions replied, and some which did failed to furnish adequate information. For example, both Kitsap an King Counties provided lengthy lists of county parks. Among these, several considerable areas were listed as "undeveloped." I am personally acquainted with some of these undeveloped parklands, and know them to be fine habitat enclaves. However, my criterion was for land *dedicated* to nature conservation as the primary management form. Since undeveloped parklands can be developed rapidly, the new facilities often obliterating former habitat, simply being undeveloped does not qualify an area for consideration here. Other park departments perceived that crucial difference and carefully indicated which parks would remain in an undeveloped condition as a matter of policy.

I do not think, however, that the relative proportions of land reserved which is here reported would be drastically changed in the light of all possible reserve information. The relative amounts of each butterfly province of Washington which are secure from a biological conservation standpoint can, I think, be reliably judged from the reserve acreage totals computed in this study, as of 1976.

A tabulation of every reserve tallied and its acreage would be bulky and would reveal relatively little by itself. Therefore, the area totals per province will be given in the *Results* section below. Characteristic reserves, agency attitudes, remarks and policies were discussed by Pyle (1976b).

Data Analysis. Each record was scored for the Geo-Code sub-unit in which it fell. USGS topographic maps facilitated fairly precise location of most records, although an early conclusion was that lepidopterists, including the writer, should be far more precise in their designation of place names and vicinities. The use of latitude/longitude or township and range designation would materially reduce the arduousness of a project such as this. Records which could not be situated with reasonable certainty were not incorporated. A useful reference was *The Lakes of Washington* by E. E. Wolcott, Volumes I and II (1964, 1965).

Machine methods could have been applied to the treatment of data and the making of maps for this study. Since there were approximately 10,000 butterfly records involved, computer use

[1]Since completion of this study, the writer has made his home in Wahkiakum County. A later re-examination of the data will indeed include numerous records from the county.

would have been appropriate. However, since records were still coming in as this analysis was being written; since I wanted stage-by-stage contact with the data in order to re-evaluate my thinking about the designation of provinces as the work progressed; and since developing the computer program would have taken as much time as the machine analysis would have saved, I elected to treat the data and prepare the maps manually.

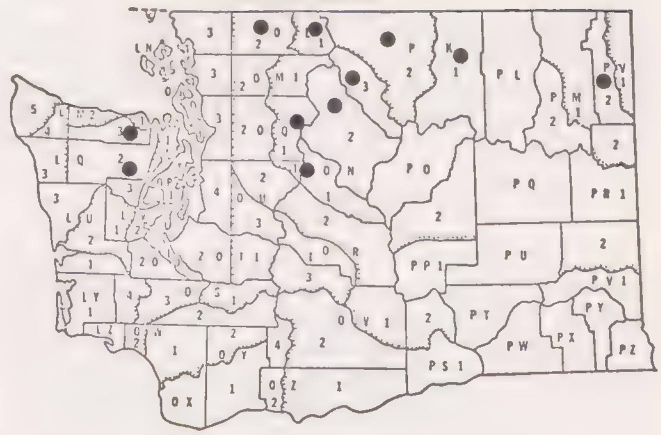
I first attempted to plot each record on a dot-distribution basis, but found this to be overwhelmingly time-consuming. Instead, each Geo-Code sub-unit received a map dot on the map of each species which was recorded from it. This produced 136 maps which showed the generalized distribution of each species of butterfly in Washington State, of which Fig. 2 is an example. In the case of very local species in large sub-units, the dot was placed with some precision as to location. For more wide-ranging species, a central position in the sub-unit served for dot-placement. In this way, the range-outline maps which were drawn next could be considered as reflecting the real range of each taxon within the state as it is currently known. I do not feel that drawing the range outline maps based on all available records would give a very different impression, since the Geo-Code sub-units do appear to delineate all but the most restricted ranges fairly well. That is, if a butterfly occurs in the sub-unit at all, it can be expected with reasonable assurance in other parts of the sub-unit, depending of course on habitat. The records bore this out. Reiterating, more limited species were plotted with greater exactitude.

Following the preparation of range-outline maps for each species, a composite map whereupon range limits were superimposed was drawn (Fig. 3). Such maps (known colloquially as "spaghetti maps") were used by Armstrong (1972) to suggest "areas of natural distribution separated by zones of rapid faunal change." The coincidence of many range edges within a narrow zone is taken to illustrate a barrier. In constructing the composite map, species which are extremely vagile or migratory, those which occur unpredictably or essentially throughout the state, and three pairs of species which were lumped because of taxonomic confusion were excluded, in order not to obfuscate real patterns which might emerge from the superimposition of more limited species' ranges. It should be noted that this entire process might have been applied at the subspecific level, had their relationships been well enough understood. This would have had the result of increased precision in the definition of barriers, since a larger number of limited ranges would have been considered. A total of 116 species' ranges were superimposed on the composite map.

Faunal resemblance calculation. From basic patterns suggested by the composite map, the test butterfly provinces were next drawn. Provinces consisted of combinations of Geo-Code sub-units. Species totals were tabulated for each newly erected province, from the sub-unit data sheets. Between each two provinces which shared a common border for a substantial distance, and therefore might be considered to be parts of the same provinces unless faunal differences showed otherwise, faunal resemblance calculations were made.

Mathematical comparison between two or more faunas to determine the degree of difference, whether to define biogeographical units or to complement theoretical research on species diversity, has occupied many investigators. I do not propose a full review of the subject here. There have been two basic lines of development in resemblance theory. One of these, of which the Shannon-Wiener information index is the accepted

Map 056. Erebia vidleri



Map 057. Erebia epipsodea

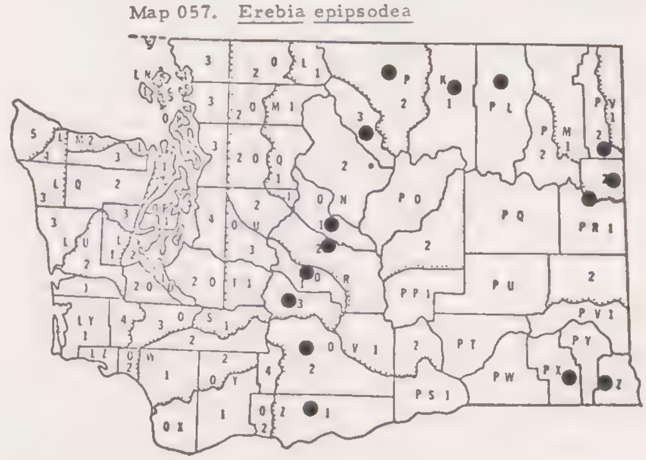


Figure 2. DOT-DISTRIBUTION MAPS. These are examples of the dot-distribution maps used to represent butterfly distribution. Each dot represents the presence of the species indicated within a Geo-Code sub-unit.

basic expression (Whittaker, 1970) takes into account abundance in the sample as well as presence. The other approach considers presence of species only, and its classical expression is Jaccard's coefficient of community (Udvardy, 1969). Since the latter characteristic was the concern of this study (as well as the extent of capability of the data, which came from diverse sources) the coefficient of community was adopted.

Long (1963) discussed variations on Jaccard-type formulae. Sokal and Sneath (1973), Pinkham (1974), and others have presented more complex ways of dealing with diversity which involve multivariate analysis. The simplicity of the coefficient of community made it ideal for the present study, whereby a basic measure of faunal arrangement was required for a comparative application.

The formula for determining coefficient of community is $R = \frac{100C}{n_1+n_2-C}$, where R is resemblance (sometimes expressed CC for coefficient of community), C represents the number of species common to both areas being compared, n_1 is the number of the smaller fauna and n_2 equals the larger fauna. The values obtained by these calculations are expressed in a trellis diagram in Table 1. Blank spots in the trellis occur where two

Table 1. FAUNAL RESEMBLANCE TRELLIS

See text for full explanation. Only those squares are occupied that represent contact between two butterfly provinces along a substantial common border. Resemblance values were not calculated for non-adjacent provinces. The figures in the lower left half of the trellis indicate value **C**, the number of species common to the two provinces being compared. The figures in the upper right triangle represent **R**, the coefficient of community, or resemblance value, derived for a pair of bordering provinces.

	Pend Oreille	Spokane-Palouse	Snake	Okanogan	Columbia	Yakima-Methow	Nooksack	Snoqualmie	Cowlitz	White Salmon	Deschutes	Willipa	Bogachiel	Elwha	Duwamish	Rosario
Pend Oreille	60	32		62												
Spokane-Palouse	25	44	43		42											
Snake		43	99		61											
Okanogan	52			76	40											
Columbia		33	63	41	68	52										
Yakima-Methow					66	125	27	56	28	55						
Nooksack						34	34	45							54	50
Snoqualmie						72	34	75	37		47				55	
Cowlitz						35		30	37	41	45	36				
White Salmon						70			32	73						
Deschutes								37	24		40	51			59	
Willipa									18		24	31	24	40	52	
Bogachiel												8	11	19		
Elwha												25	11	57	52	46
Duwamish							31	46			35	29		38	54	46
Rosario							21							27	26	29

R

C

provinces do not abut one another, and so were not tested for resemblance.

The next procedure involved readjusting provinces which failed to satisfy the criterion of distinctness. Both Dasmann (1973) and Hagmeier (1966) arrived at 65% faunal resemblance (R in the above formula) as the level of separation into distinct mammal provinces. Preston (1962) theoretically arrived at a similarity value of 73% as representing the threshhold between homogeneity and heterogeneity, and Hagmeier and Stults (1964) determined that this figure equalled a CC (=R) value of 62.5%. Therefore it seems justifiable to accept faunal resemblances of less than 62.5% as being indicative of the existence of different faunal provinces. Figure 4 presents the butterfly provinces of Washington as derived by this method. The initial computation of faunal resemblances eliminated only one proposed province, which was the northern portion of the Yakima-

Methow province. Its similarity with the southern portion was R=80.95, a figure much higher than the allowable 62.5%, so the two units were clumped. (The figures given in the trellis, Table I, are antecedent to this adjustment.) The composite range map, as can be seen by a comparison of Fig. 3 with Fig. 4, gave a representation which was highly suggestive of real barriers, and did not suggest the separation of the eastern Cascades into northern and southern units, which division was shown to be unsupportable by the faunal resemblances. The relationship between the butterfly provinces and other natural divisions of Washington will be considered in the "Discussion" section below.

Once the provinces had been composed, it remained to compare their areas with the amount of each which qualified as nature reservation. The assumption was made that an acre-to-acre comparison was a valid one, since the integrity of each province in a biotic sense had already been established. The combination of Geo-Code sub-units to produce the provinces involved fragmenting counties, so measurement of the areas of the provinces presented a problem. This was accomplished through morphometric measurement, whereby a map of the provinces was cut into segments and the weights of the pieces compared with the weight of an equal, uncut map of the state, using a sensitive laboratory balance. Since the area of the state was known, the areas of the provinces could then be calculated algebraically. The provinces had then been established and defined both in terms of their respective butterfly faunas and their areas, and they were given the names of prominent rivers which bounded or drained them.

Finally, the percentage of each butterfly province which had been designated for management primarily for purposes of nature conservation was computed.

Results

The results of the areal comparison between provinces and reserves are presented in Table 2. Additional figures on this table represent the diversity of the butterfly fauna within each province. The results expressed in Table 2 were drawn from the data, computations, maps and Table 1 above. As can be seen, a wide spread exists in the amounts of each province which have been dedicated to habitat conservation. Consideration of these differences should, therefore, suggest priorities for future concentrations of nature reserve efforts in Washington. With percentages of land reserves ranging from 0.18% for Deschutes Province to 57.06% of Elwha Province, a basic ordering of sorts is obvious. However, site-specific factors such as habitat opportunities, the distribution of reserves within provinces and human disturbance and political factors render such a simple numerical ordering overly simplistic. These kinds of factors and the more complex set of priorities which can be drawn from them are considered below.

Table 2. RESULTS: CHARACTERISTICS OF THE BUTTERFLY PROVINCES

The first column names the butterfly provinces developed in this study. The second and third columns show the number of butterfly species recorded for each province to 1976, and the percentage of the total state fauna that represents. In the fourth and fifth columns the acreage of each province is given in millions of acres, followed by the percentage of the total state it accounts for. The sixth, seventh and eighth columns give nature reserve data consisting of the area reserved in each province (in thousands of acres); the number of reserves considered in the tabulation, and the percentage of each province set aside for biological conservation. Comparison of the figures in the final column will suggest a basic ordering for future geographical priorities in state nature reserve planning.

PROVINCE	SPECIES		AREA		RESERVES		
	No.	% WA	Acres x 10^6	% WA	Acres x 10^3	No.	% Prov.
Pend Oreille	60	44	1.27	2.9	2.4	3	0.19
Spokane-Palouse	44	33	1.44	3.3	19.2	3	1.34
Snake	99	73	2.92	6.7	106.6	12	3.65
Okanogan	76	56	4.36	10.0	50.6	3	1.16
Columbia	68	50	7.42	17.0	377.3	23	5.08
Yakima-Methow	125	93	8.85	20.7	1218.6	32	13.77
Nooksack	34	25	0.87	2.0	314.2	16	36.00
Snoqualmie	75	56	3.80	8.7	589.0	12	15.51
Cowlitz	37	27	2.40	5.5	83.4	2	3.49
White Salmon	73	54	1.49	3.4	37.4	7	2.51
Deschutes	40	30	0.90	2.1	1.6	2	0.18
Willipa	31	23	2.14	4.9	17.2	13	0.81
Bogachiel	11	8	1.29	3.0	29.0	4	2.24
Elwha	57	42	1.52	3.5	866.7	4	57.06
Duwamish	54	40	2.41	5.5	9.4	54	0.39
Rosario	29	21	0.37	0.8	3.8	27	1.04
WASHINGTON	138	100	43.64	100	3729.2	217	8.53

Figure 3. COMPOSTE RANGE MAP. On this map, the approximate range-limits of 116 species of Washington butterflies have been superimposed. Migrant, wide-ranging and nearly ubiquitous species were omitted. The coincidence of many range limits in a restricted zone indicates the presence of biogeographical barriers for butterflies. The outstanding barriers in the central portion of the map are the Cascade Crest and the western edge of the Columbia Basin. Other barriers, and the relationship between this map and the butterfly provinces, are discussed in the text.

Discussion

Butterflies as regional diversity indicators. Because of their different propensities for dispersal, degrees of vagility, substrate (prey, soil, etc.) specificity and other such characteristics, different groups of organisms serve the purpose of regional diversity indication more or less well. Regardless of its higher taxonomic affinity, an animal or plant defines regionality proportional to its likelihood of remaining predictably within a circumscribed region. Groups of species, then (i.e., genera, families, orders) serve as regional depictors as well as the majority of species included in them. Mammals, for example, which have frequently been employed for biotic provincialization (Hagmeier, 1966), function well in this capacity because (particularity at a subspecific level) they tend to occupy fairly restricted ranges, relatively few of them behaving as eurychores. The overall suitability of mammals for this purpose is reduced, however, by the very high degree of disruption of mammal faunas which accompanies human use of areas, and the direct management of mammal populations by humans. Birds are problematic for regional studies because of their exceedingly great vagility, which allows even non-migratory species to make large seasonal adjustments in their ranges depending upon food supply. Plants, chiefly vascular, are the group which traditionally has been employed for ecological characterization (Kuechler, 1973), although less so for regional biogeographical studies. Again, the great ability of plants to disperse in the seed stage (as well as the presence of many aliens) detracts from their ability to indicate regionality. The marked site-specificity of many plant genera, however, makes them ideal for life-zone and community marking, and the term "indicator species" in fact usually refers to plants.

Butterflies as a group share certain properties which suit them quite well as regional biogeographical indicators. They are quite vagile, yet limited in their vagility by short life-span and vulnerability to weather and predators. They are somewhat to extremely host-specific, generally speaking. While they have indeed been affected in their ranges by human factors, their high reproductive potential has equipped them to resist many kinds of human impact which have altered vertebrate populations to a greater extent. Butterflies occur in greater diversity than mammals, but in lower species numbers than plants. This medium diversity seems to me to have two advantages. First, the number of species is high enough to be useful quantitatively, yet low enough to be handled efficiently—the butterfly fauna is rich but finite. Second, since butterflies are all dependent upon plants as their hosts, and in most cases just one or a few species of plants each, they tend to rarefy the vast amount of ecological information available in plants—by reading the butterfly fauna, one reads the flora in a condensed form.

Of course, the above observations relate to butterflies in general. Some butterflies share catholic taste in foodplants with prodigious dispersive ability, and these are of little use in characterizing regions. One butterfly in fact, the Painted Lady (*Vanessa cardui*), is such a eurychore that an optional vernacular name for it is Cosmopolitan Butterfly. Different dispersal tactics of butterflies are discussed by Brussard and Ehrlich (1970). Species with intrinsic barriers to dispersal would presumably be more useful for regional studies than those with

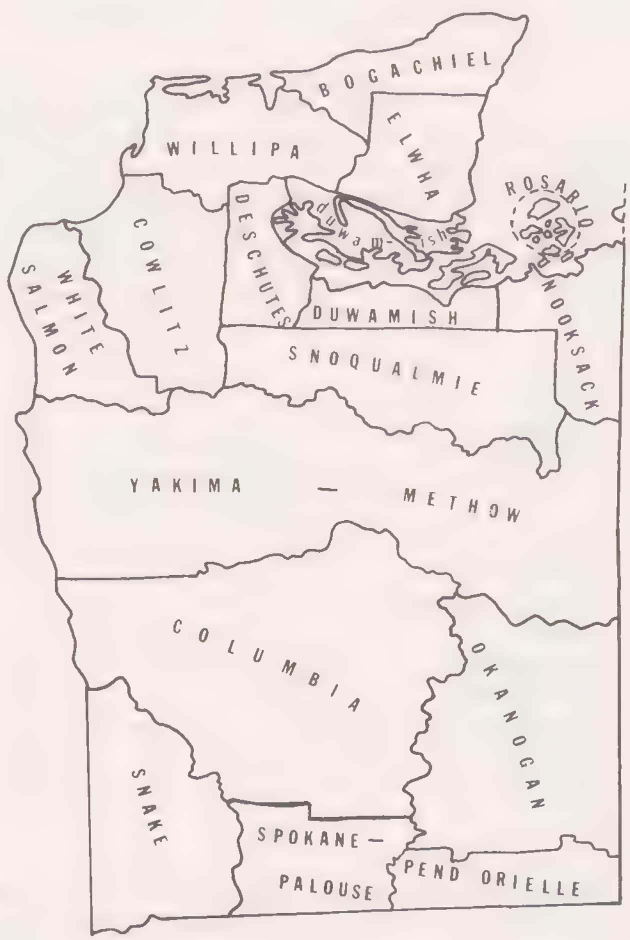


Figure 4. BUTTERFLY PROVINCES OF WASHINGTON. These are the biotic provinces, as demonstrated by butterfly faunal patterns, derived by this study. They bear the names of prominent rivers in each section of the state.

large, continuous populations and free movement; but even these would define regionality if limited by major barriers. Only the true eurychores and wandering species which appear unpredictably have relatively little value in visualizing natural regions.

In practice, butterflies served quite well as biogeographical indicators as employed in the present study. Unlike Holland (1974), I included free-moving species in the calculations of faunal resemblance, since this study is concerned with butterflies as a natural resource and the free-moving species often comprise a disproportionately high number of the highly visible butterflies in an area. The effect of including such species is to exaggerate the actual faunal similarity between provinces. Since all but one of the proposed provinces proved to be distinct anyway, the inclusion of free-moving species did not alter the results. These species were not, however, employed in the construction of the composite range map because of the conclusion stated above, that they do not help to visualize regionality. Some groups of butterflies proved to be more useful than others as zoogeographic keys. For example, nearly all of the hairstreaks (theclines) exhibited strong regionality, most of them in fact being restricted to the eastern Cascades. The Hesperiidae on the whole served as excellent indicators, with the exception of the ubiquitous *Ochlodes sylvanoides*. Specifically montane general such as *Erebia, Oeneis* and *Boloria*; and markedly arid lowland genera such as some *Cercyonis, Euchloe* and certain *Pieris* were very helpful. Butterflies which proved poorer delineators included the migrators and immigrants such as *Danaus plexippus* and *Vanessa* ssp., many of the nymphalines which are both exceedingly vagile and predators of weedy or common plants, the one introduced species (*Pieris rapae*) and others which feed on cultivated crops (*Colias* spp. on alfalfa, *Strymon melinus* on hops and beans, etc.) and the several super-generalists which will be discussed below under biogeographical patterns.

The superimposed ranges of 116 Washington butterflies (Fig. 3) coincide enough to give a strong impression of operative biogeographic barriers. What these barriers are, the edges of range in fact, are considered below in the discussion of biogeographical patterns among Washington butterflies. That they bear a degree of reality was borne out by the faunal resemblance calculations to which the proposed butterfly provinces (themselves derived largely from the composite range map) were subjected. By comparing Fig. 3, the composite range map, with Fig. 4, the butterfly province map, one can see clearly that most of the mathematically supportable provincial boundaries reflect strongly in the heavy coincidence of species' ranges. I conclude, therefore, that the selective use of butterflies as indicators of biotic regionality is a suitable technique for biogeographic expression.

The butterfly provinces of Washington as arrived at in this paper have been compared with different authors' views of the natural divisions of Washington State (Figs. 5-8). Physiographic provinces for Washington seem first to have been suggested in publication by Culver (1936). Culver's divisions have survived and are essentially the same as those shown by Franklin and Dyrness (1973). Since the physiographic provinces are based on the environmental features which compose substrates for biological systems, one might expect them to correlate rather closely with biotic regions. As Dalquest (1948) pointed out, such correlations may be perturbed by historical factors and isolation by geographic barriers. There is a fair degree of correlation between the butterfly provinces constructed in this paper (Fig. 4) and the physiographic provinces (Fig. 5), but it is by no means complete. The Columbia Butterfly Province (BP) roughly coincides with the Columbia Basin, but parts of the latter have been placed in the Yakima-Methow, Spokane-Palouse and Snake BPs. The Blue Mountains are traditionally considered narrowly as a physiographic province, but I expanded their influence north to the Snake and Palouse Rivers. Other butterfly provinces which splinter off from the traditional physiographic provinces are the Pend Oreille, the Nooksack, the Bogachiel and the several provinces of the Puget Sound Trough, including the Rosario. There are supposed to be distinct Northern Cascades and Southern Cascades Provinces physiographically, but, as I have shown, these are not supportable by faunistic differences among butterflies.

The butterfly provinces give a finer degree of resolution to the state than the major North American biotic provinces of Dice (1943), which were among the first organismal divisions to be named for the state. Naturally, working on such a large scale, Dice delineated the regionality of states rather coarsely (Fig. 6). His three provinces which encompass Washington (Oregonian, Palusian, and Montanian) are here increased to 16 units. Perhaps they should be considered sub-provinces, or districts (a subordinant term employed by Dice). Even so, comparing Fig. 4 with Dice's provinces reveals that his units define quite sharply the origins of the Washington fauna as suggested in my discussion of biogeographical patterns.

A comparison of a closer scale can be made between the butterfly provinces and the mammalian distributional areas of Washington as suggested by Dalquest (1936). Dalquest did not mathematically compute the resemblances between these provinces, but he based his assessment on the same approximate number of specimen records that were employed in the present study (about 10,000). He proposed seven mammalian distributional areas (Fig. 7), including a single Western Washington area which contains all or most of nine of the butterfly provinces. He placed the main body of the Cascades in a single province, as I did, but included part of the west-of-the-crest Snoqualmie Province. Interestingly, Dalquest separated off a Yakima Valley area which covers part of my Yakima-Methow and part of the Columbia Butterfly Province. I found this area enigmatic, with strong Columbian intrusions, but also with eastward-extending ranges of hills which carried the southern Cascade fauna out toward the basin. I consider Dalquest's Yakima Valley as a broad border, rather than a province, but he cited mammalian evidence for its separation. Dalquest made a distinct Southeastern Washington area, as did I, south of the Snake River; but he further segregated the Blue Mountains within that area, and this may indeed be justified. Finally, we agreed on the western border of the Okanogan Province, as the Okanogan River, rather than taking it up through the Okanogan Highlands to the Cascade Crest. He recognized no Pend Oreille or Spokane-Palouse units, but included these areas within his Northeastern Washington region, thus indicating their common Rocky Mountains affinities. The butterfly and mammal provinces agree fairly closely in their recognition of broader patterns of regionality, thereby reinforcing one another. One cannot expect biotic or faunal provinces based on different groups of organisms to conform completely with one another, since important factors such as dispersive ability, colonial potency, habitat tolerance, and adaptive ability are highly idiosyncratic. So amphibians, for example, or epiphytic plants, might well be capable of a finer degree of characterization of the rain forest coastal provinces than are sunlight-adapted butterflies.

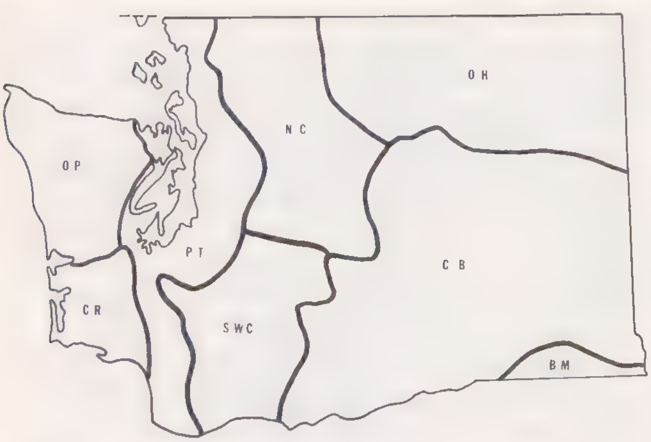


Figure 5. THE PHYSIOGRAPHIC PROVINCES OF WASHINGTON. After Franklin and Dyrness (1973). OP = Olympic Peninsula; CR = Coast Ranges; PT = Puget Trough; NC = Northern Cascades; SWC = Southern Washington Cascades; OH = Okanogan Highlands; CB = Columbia Basin, an BM = Blue Mountains.

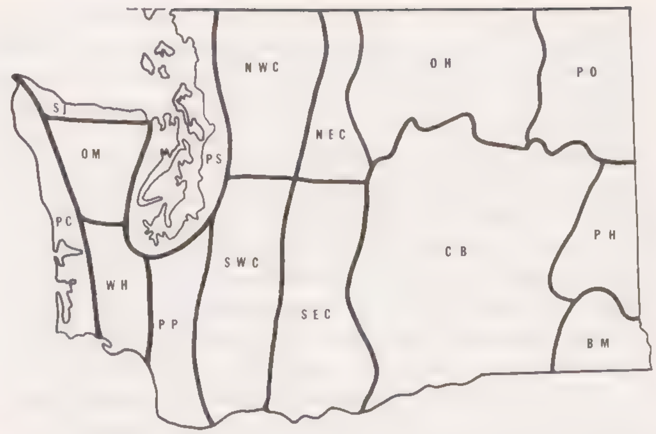


Figure 8. PREVIOUSLY PROPOSED BUTTERFLY PROVINCES IN WASHINGTON. After Pyle (1974). SJ = Straights of Juan de Fuca; PC = Pacific Coast; OM = Olympic Mountains; WH = Willipa Hills; PP = Puget Prairies; PS = Puget Sound; NWC = Northwest Cascades; SWC = Southwest Cascades; NEC = Northeast Cascades; SEC = Southeast Cascades; OH = Okanogan Highlands; CB = Columbia Basin; PO = Pend Oreille; PH = Palouse Hills, and BM = Blue Mountains.

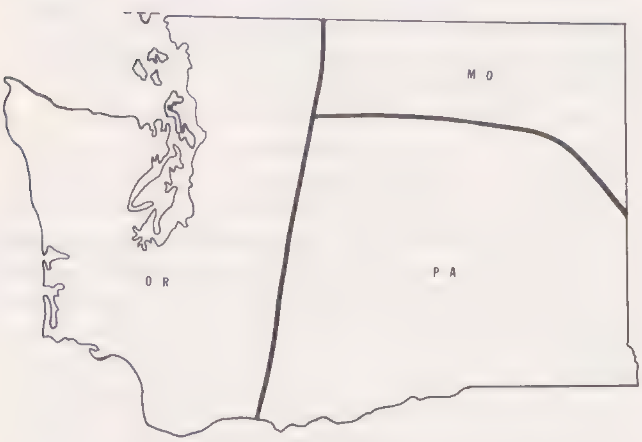


Figure 6. DICE'S BIOTIC PROVINCES OF WASHINGTON. OR = Oregionia; MO = Montanian, and PA = Palusian.

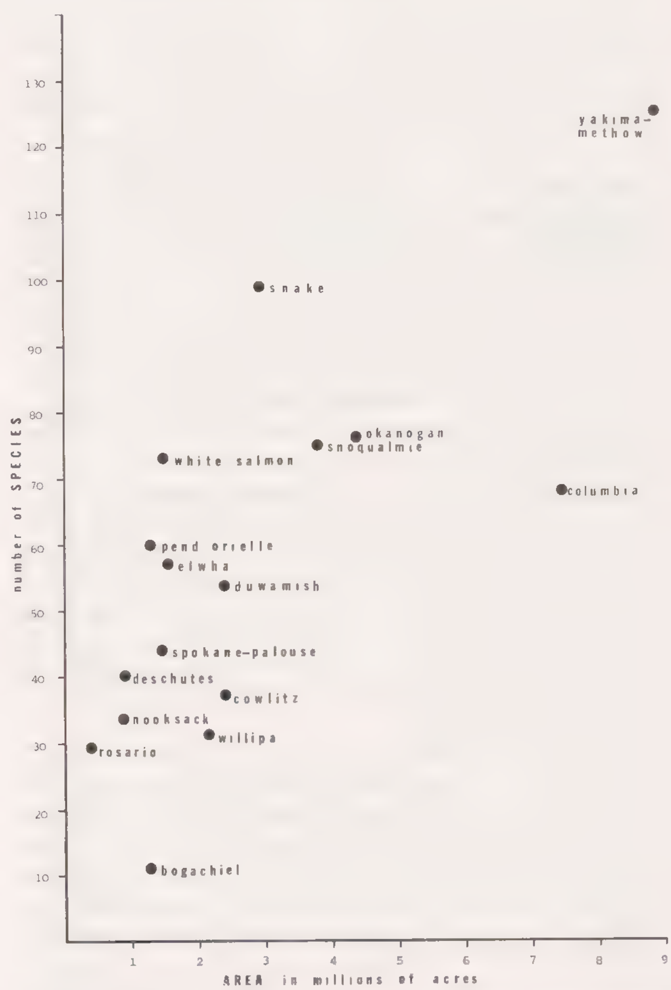


Figure 9. DIVERSITY AND AREA OF THE BUTTERFLY PROVINCES. The vertical axis expresses the number of species present in each butterfly province, while the horizontal axis indicates the respective sizes of the provinces.

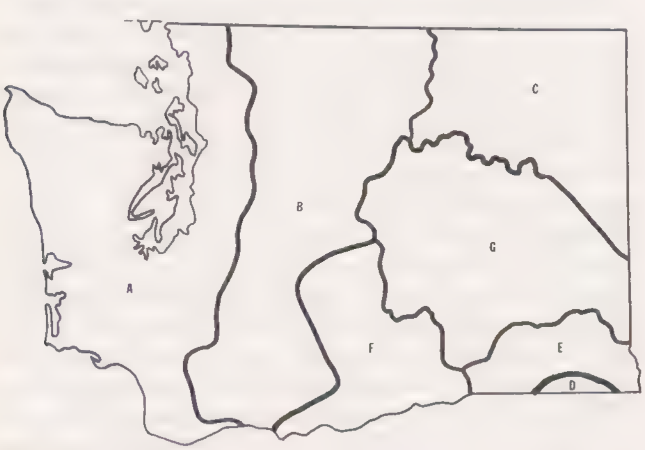


Figure 7. THE MAMMALIAN DISTRIBUTIONAL AREAS OF WASHINGTON. After Dalquest (1948). A = Western Washington; B = Cascade Mountains; C = Northeastern Wasington; D = Blue Mountains; E = Southeastern Washington; F = Yakima Valley, and G = Columbian Plateau.

Figure 8 represents the butterfly provinces which I intuited previously (Pyle, 1974). The differences between these and the units suggested in this study should be clear from the maps. The old and new arrays resemble one another in the eastern provinces, less so in the West, where the biogeographic situation is more complex than I had realized before. The northerly confinement of the Deschutes stands out.

Butterflies as site indicators. The main thrust of this paper is biogeographical rather than ecological, so the potential of butterflies as community or site indicator species is less germane than their ability to show biotic regions. Nevertheless, one of the chief reasons conservationists give for conserving butterfly populations is their value as ecological indicators. It seems appropriate, therefore, to discuss this aspect briefly. Simply speaking, the more specific a butterfly is to a site, the more particular information it can yield about that site. Again, the observations of Brussard and Ehrlich (1970) concerning contrasting dispersal strategies are relevant here. Butterflies with low vagility and limited ranges denote site uniqueness far more than wide-ranging species. Local demes which have evolved distinct facies are perhaps the most useful butterfly expressions of site conditions. Thus, the Atossa Fritillary (*Speyeria adiaste atossa*), prior to its supposed extinction, adapted highly distinctive appearance in response to the environmental conditions of the Tehachapi Mountains near Los Angeles (Orsak, 1974). During the course of these studies, certain outstanding cases of the propensity of butterfly populations to indicate site uniqueness were discovered. These will be described below, in the discussion on the butterfly provinces and their conservation priorities.

Biogeographical patterns among Washington butterflies. Analyzing the distributional records of Washington butterflies brought to my attention a number of striking and recurrent biogeographical patterns. Before considering these, it is interesting to note the relationship between the size of the butterfly provinces and the number of species which occur in them. If the number of species is plotted against the area of provinces (Fig. 9), a general trend is observed whereby species number rises with size of province, which one would expect, all other factors being equal (MacArthur and Wilson, 1967). In fact, the largest province by far also exhibits by far the highest number of species (Yakima-Methow Province: 8,848,400 acres, 125 species). The smallest province has the second lowest number of species (Rosario Province, 376,000 acres, 29 species). Several of the provinces, however, lie rather far above or below the point on the graph which might be expected for their size. Bogachiel Province, fourth smallest, possesses the fewest species (1,291,800 acres, 11 species). This reflects the fact that the Olympic Rain Forest, a vegetational unit which comprises much of this province, offers suitable habitat for very few butterflies. Densely forested and extremely high in precipitation, the Bogachiel Province includes very little of the open, sunny landscape to which most butterflies are adapted. Cowlitz Province exhibits the same situation less dramatically. The fact that little Rosario Province, which comprises the San Juan Islands, harbors as many species as it does can be explained in contrasting terms to the reasons for Bogachiel's depauperate condition. Almost wholly open, lying in the rain shadow of the Olympic Mountains and therefore quite sunny, and largely natural in condition with a rich flora including potential host plants and nectar sources for many species, the islands constitute a very good butterfly environment which would probably be even richer were they not isolated both by water gaps and heavily forested neighboring areas.

Snoqualmie Province has 75 species on 3,796,900 acres while Columbia Province has yielded 69 species on 7,423,700 acres. At least two main factors are operative here. First, while definitely a unit biogeographically, the Snoqualmie Province (or Western Cascades) includes several life zones and a large proportion of subalpine meadows, which are notably rich in butterflies. The Columbia Basin constitutes a single life zone which, as the range maps show, many species clearly avoid due to its aridity. Actually, I think that a measurement such as this, had it been taken in aboriginal times, would have revealed a strikingly different picture. The Columbia Province has been so massively altered ecologically by human effects—damming of the Columbia River and concomitant inundation of riverine habitats, irrigation of arid lands with resultant community changes, conversion of large expanses of *loess* soil-lands from short-grass prairie to wheat monoculture, and overgrazing of remaining grasslands with the consequence of replacement of native grasses by cheatgrass (*Bromus tectorum*) (Franklin and Dyrness, 1973)—that many local extinctions must have taken place. Whether this actually eliminated many species from the entire Columbia Province is a matter of conjecture, but I suspect that it did; and therefore, that the skewed area/diversity relationship shown by this province is a historical artifact. Alternatively, it is possible that the richness displayed by intact communities in more continental plains regions never did evolve here, due to biogeographic isolation.

The other side of the picture is the disproportionately high number of species in the Snake Province. With 2,924,100 acres, the Blue Mountains and nearby lands host 99 species. Though small and low (under 7,000 feet, never attaining truly alpine aspect or habitat), the Blue Mountains offshoot in Washington manage to maintain many of the montane butterflies which fly in the Cascades and Olympics. Columbian lowland species enter the area on its Snake River Canyon edges, and two species (see below) occur only in this province in Washington. It seems to possess a compact but suitable mixture of habitats for many species, and to be fortuitously placed for immigration from the south. The Blue Mountains are largely in their natural condition, as well. As for the Yakima-Methow Province, which supports 125 of the state's 139 species, the explanation is fairly clear. A vast area, composed largely of sunny foothills, canyons and alpine forests and meadows, situated along a major zoogeographical corridor from both north and south, and largely natural in condition, the Yakima-Methow Province is singularly suited among Washington regions for high butterfly diversity.

Distinctive and recurring patterns of distribution among Washington Rhopalocera fall into a number of broad categories. Examination of these suggests possible important geographical origins of the state's fauna. Prior to speculating on such origins, I will briefly describe the outstanding patterns and give examples of species which conform to them.

1) East of the Cascade Crest only, generally well distributed in Eastern Washington (*Colias alexandra, Lycaena heteronea, Plebejus melissa, Papilio multicaudata*)
2) Eastern Washington, except crossing the crest in South-Central Washington where the Cascades barrier breaks down (*Glaucopsyche piasus*)
3) West of the Cascade Crest only, very local in Western Washington (*Incisalia polios, Mitoura johnsoni*)

4) Generally distributed in Western Washington, boreal parts of Eastern Washington (*Pieris "napi," Parnassius clodius, Polygonia oreas*)
5) All mountainous parts of the state (Olympics, Cascades, Okanogan, Pend Oreille, Blue Mountains) (*Parnassius phoebus, Phyciodes campestris, Euphydryas colon, E. editha, Lycaena mariposa, Plebejus saepiolus, P. argyrognomon*)
6) Eastern Cascades only (*Speyeria callippe, Satyrium behrii*); with variations:
   Eastern Cascades and Blue Mountains (*Cercyonis sthenele, Speyeria egleis, Harkenclenus titus, Satyrium fuliginosum, S. saepium, S. sylvinus*)
   Eastern Cascades and Columbia Basin (*Lycaena rubidus*)
   Eastern Cascades, Blue Mountains, Okanogan, and Pend Oreille (*Erebia epipsodea, Speyeria atlantis*)
   Eastern Cascades, Blue Mountains and Okanogan (*Papilio indra, Cercyonis sthenele*)
   Eastern Cascades and eastern border areas (*Callophrys sheridanii, Thorybes pylades*)
   Eastern Cascades and disjunct Western Washington population (*Amblyscirtes vialis*)
7) Cascade Range, both sides of crest, but no other mountains (*Chlosyne hoffmanni*)
8) Columbia Basin only (and immediately adjacent lowlands) (*Euchloe ausonides, E. hyantis, Pieris beckerii, Papilio oregonius, Limenitis archippus*)
9) Widespread in state but absent from Columbia Basin (*Erynnis icelus, Neophasia menapia, Papilio eurymedon, P. rutulus, Speyeria hydaspe, Boloria epithore, Polygonia faunus, Everes amyntula, Celastrina ladon*)
10) Intrusions on East (*Boloria bellona, Phyciodes tharos*)
11) Intrusions on Southeast (*Lycaena editha, Apodemia mormo, Nathalis iole*)
12) Intrusions on Southwest (*Polites mardon, Euphyes vestris, Adelpha bredowii*)
13) Intrusions on Northeast (*Oarisma garita, Polites mystic, Colias interior*)
14) Intrusions on North (North Cascades and Okanogan, different areas of entry and various degrees of penetration to south) (*Erynnis pacuvius, Pyrgus centaureae, Polites themistocles, Colias nastes, Papilio glaucus, Oeneis melissa, Boloria astarte, B. freija, Euphydryas anicia, Nymphalis vau-album, Lycaena cupreus*)
15) Widespread species with distinctive, disjunct subspecies (*Speyeria leto, S. zerene, Hesperia comma* complex (disjunctures in Olympics and San Juans), *Callophrys dumetorum, Incisalia mossi, Mitoura nelsoni*)
16) Relicts, disjunct and not near a border (*Hesperia nevada, Boloria selene*)
17) East/West Cascades, with disjunct population in San Juan Islands (*Oeneis nevadensis*)
18) Olympic Mountains disjunctures: variations—
   Cascades (both sides) and Olympics (*Boloria titania, Agriades glandon, Pieris occidentalis, Erebia vidleri*)
   Eastern Cascades and Olympics, but not Western Cascades (*Pieris sisymbrii, Oeneis chryxus, Lycaena nivalis*)
19) Other mountainous regions but absent from Olympics (*Erebia epipsodea, Speyeria mormonia, S. coronis*)
20) Strictly limited by host plant (*Erynnis propertius/Quercus garryana, Mitoura siva/Juniperus occidentalis*)
21) Expanding widely due to cultivated host plants (*Colias eurytheme, C. philodice, Polites sabuleti, Strymon melinus*)
22) Common unpredictable wanderers (*Vanessa cardui, C. annabella, Vanessa atalanta*)
23) Rare unpredictable wanderers (*Vanessa virginiensis, Danaus plexippus*)
24) Eurychores 1: Widespread and common, but not ubiquitous, each absent from many habitats (*Nymphalis antiopa, N. californica, N. milberti, Polygonia satyrus, Papilio zelicaon, Cercyonis pegala, Anthocharis sara, Glaucopsyche lygdamus*)
25) Eurychores 2: Practically ubiquitous, occurring when no other butterflies are present in many cases (*Ochlodes sylvanoides, Pieris rapae, Coenonympha ampelos, Phyciodes mylitta, Limenitis lorquini, Lycaena helloides*)

The foregoing 25 patterns seem to me to be the most prominent ways in which butterflies are distributed in Washington. It is not proposed to undertake an in-depth consideration of the historical biogeography of Washington butterflies here. However, a few speculations may be drawn from these patterns.

The Cascade Range clearly is the dominant influence on the state's fauna. The great majority of the species occur at some point or other in the Cascades. Without examining the surrounding regions in detail, it is somewhat difficult to assess how much of the Cascadian fauna came from the south and how much from the north. It seems likely that many of the species which range all along the Cascades are continental, e.g. from the south and east *via* the southern Cascades and the Basin and Range regions of Oregon and Nevada. An obvious northerly, boreal and arctic element is present, limited today to the North Cascades, Okanogan and Olympics with some more southerly outposts. Since members of this fauna enter the state at different areas and penetrate southerly to different degrees, a strictly common regional origin is doubted. Some species, such as *Boloria astarte, Oeneis melissa* and *Colias nastes* would seem to be of far northern origins, coming down the Rockies and their outliers. Others, including *Lycaena cupreus* and *Oarisma garita*, suggest a source in the main body of the Rockies, *via* the Selkirks; while still others of the northern border fauna are eastern and boreal butterflies, such as *Nymphalis vau-album* and *Papilio glaucus*. However, if *Nymphalis vau-album* is conspecific with the Asian species as I have interpreted it, an Old World origin must be considered, as it must for the Holarctic species *Pyrgus centaureae* and *Carterocephalus palaemon*. Rocky Mountain influence is also felt through the Blue Mountains, where *Lycaena editha* flies, lending a distinctly Central Rockies character to the area.

Patterns are more obscure in Western Washington. *Adelpha bredowii*, recorded only from the Vancouver, Clark County area, is the only obvious Californian element, with the possible exception of others which have become fully assimilated and phenotypically differentiated in Washington such as *Limenitis lorquini*. Very few coastal populations occur, one notable maritime endemic being *Speyeria zerene hippolyta* on the Long Beach Peninsula. Puget Sound is rather depauperate, but certain local and distinctive demes occur there, including *Speyeria leto pugetensis* and *Incisalia polios*, the former with a presumably Cascadian/Rockies origin, the latter seeming a boreal, post-Pleistocene relict. On the San Juan Islands occurs at least one butterfly of Vancouver Island origin, the locally disjunct population of *Oeneis nevadensis*. Some of the most interesting biogeographical enigmas in Western Washington occur in the Olympics. It is curious that certain species fly in these isolated mountains and in the Eastern Cascades and Blue Mountains, but not in the Western Cascades (*Pieris sisymbrii,*

Lycaena nivalis); while other alpine butterflies have not made it to the Olympics, notably *Speyeria mormonia*. Furthermore, some Olympic populations have evolved distinct facies, such as *Oeneis chryxus valerata*, while others like *Boloria titania rainieri* (Barnes & McDunnough) retain their Cascades form. These patterns in the Olympics point to a complicated history with several periods of isolation and contact and probably repeated instances of extinction and recolonization. Some Olympic taxa, perhaps *O. c. valerata* among them, may have a British Columbian origin *via* Vancouver Island rather than a past linked to the Cascades.

The outstanding barriers to butterfly dispersal into Washington and movement within the state are the arid Columbia Basin, the Columbia River on the south, the Cascade Crest (respected by some species, straddled by others), the Straits of Juan de Fuca, and perhaps most of all the dense, nearly unrelieved forest of Western Washington. The prevailing corridors for movement into the state and throughout its regions, include the eastern Cascades ranges and canyons, the Snake and Columbia Rivers (and to a lesser degree the Yakima, Pend Oreille and Spokane Rivers) and the broad, homogeneous and unobstructed frontiers of the Okanogan Highlands and (on a much smaller scale) the Blue Mountains.

There is only one endemic butterfly species in Washington today, *Polites mardon*[2]. Of possible autochthonous origin in Washington, I consider the following most likely: *Mitoura johnsoni, Erebia vidleri, Colias occidentalis,* and *Polites mardon*.

Clearly, the butterfly fauna of Washington is the product of tridirectional influences over a very extensive time scale. The interesting present condition of the state fauna is a synthethis: a dynamic blending of major faunal forces from the Far North, the Boreal North, the northern and central Rockies, the Blue Mountains, the Great Basin, the Southern Cascades and the Californian coastal region, with a minor but distinctive regional evolutionary autochthony.

One final consideration I wish to make here is that of the remarkably depauperate nature of the butterfly fauna in much of Western Washington. Collectors have long wondered why so many seemingly "good" habitats in the western lowlands of the state should produce few or no butterflies. True, certain species have adapted to the dense evergreen forests, notably the conifer-feeding *Incisalia eryphon* and *Mitoura johnsoni*, which feeds on a parasite of a conifer, and some of their congeners. Vagile nymphalines are not uncommon in clearings in Western Washington, and the Pine White (*Neophasia menapia*) is considered overly abundant by foresters because various timber-crop evergreens serve as its hosts. But by and large, the many secondary meadows and roadsides and shorelines of Western Washington lack the butterfly richness which similar habitats in other parts of the country display. Previously I proposed that this absence may be an effect of the recency with which open habitats have become available among the large forest expanses (Pyle, 1974) Indeed, in local environments known to have been unforested over a long period geologically, such as the Tenino Prairies and the Olympic highlands, butterfly diversity is higher than elsewhere on the west side of the Cascades. Perhaps there has not been sufficient time for potential colonizers, formerly held back by the uniform forest barrier, to reach the extensive open country which has been created by agriculture and forestry.

[2]Although Morrison's type locality for *P. mardon* was named as Mt. Hood, Oregon, this is almost certainly mistaken, as is a similar designation for *Ochlodes agricola*, a Californian and Southern Oregonian element.

However, I became increasingly aware during this study of a group of species which clearly have adapted to almost every open kind of habitat in Western Washington. As I continued to find them, both in the field and in the records, in site after site where virtually no other species occurred, the fact of their "monopoly" became quite striking. Each is a rapid colonizer which feeds on either weedy species of plants or otherwise nearly ubiquitous hosts. These adventive species, and their food plants, are *Ochlodes sylvanoides* (grasses), *Pieris rapae* (crucifers), *Coenonympha ampelos* (grasses), *Phyciodes mylitta* (thistles), *Limenitis lorquini* (willows), and *Lycaena helloides* (docks). Other extremely widespread species which might possibly be considered members of this group are *Papilio zelicaon* (umbels), *Papilio rutulus* (aspens, elms, willows), *Polygonia satyrus* (nettle, elms), and *Anthocharis sara* (crucifers), although these are somewhat less ubiquitous.

These eurychores can be thought of as a sort of guild of super-generalists. By adapting to conditions (or by arriving in places) suitable for or accessible to few other butterfly species, they have become enormously successful. They do not need to compete with an array of other butterflies for nectar, since the places they occupy uniformly produce many flowers but, as noted, few butterflies. Most successful of all of these are *Pieris rapae, Lycaena helloides* and *Ochlodes sylvanoides*. During the field work for this study, I encountered *O. sylvanoides* in almost every sunny habitat I sampled in Western Washington, from vacant lots in Seattle to remote coastal salt-marshes. It was absent only from alpine areas (which had a characteristically high number of butterfly species) and deep forests (where no butterflies flew). *Lycaena helloides* is nearly as ubiquitous throughout Western Washington. *Pieris rapae* can no longer be unexpected anywhere in the state. In 1975, this alien species was found at Cape Alava, the westernmost point in the conterminous states, a cool and foggy site separated by extensive rain forests and dense coastal headlands from any habitats which most lepidopterists would consider promising for butterflies. The only other butterfly present was *A. napi,* the one regular denizen of rain-forest edges in this region.

Since two of the most successful butterflies in Washington are an introduced species (*P. rapae*) and a hesperiine skipper (*O. sylvanoides*), it will be interesting to see what happens when *Thymelicus lineola* Ochsenheimer reaches Washington, if it does. This European grass-feeding skipper has been introduced into Eastern North America and has expanded widely toward the Midwest; recently it has appeared in British Columbia, probably the result of a secondary introduction (Burns, 1966). It seems likely to expect the appearance of *T. lineola* in Washington. It seems likely also that it might then become one of the super-generalists, possibly competing as it does so with *O. sylvanoides*.

The great forest barrier of Western Washington has been opened in many places. Numerous habitats rich in larval hosts of butterflies and potential nectar sources have been created. Only a few species have so far adapted to this secondary set of niches. It may be that the actual incidence of sunshine, not only the shade which has now been mitigated, is not suitable for many species within colonzing distance; or that the precipitation is too high, or that some other factor or set of factors will interfere with the growth of the fauna. Certainly such has been the case to date: during an entire day of observation in early July, 1975, throughout numerous open and flowery habitats in Seattle, during which the weather was clear and warm, four observers sighted only three species of butterflies (S. Pyle,

1976). A much higher number could have been obtained in almost any other American city under the same conditions.

If the trend should be toward a more diversified fauna in Western Washington due to immigrations into relatively new habitats, such an outcome depends on the continued existence of those habitats. In many places, human uses are pre-empting suitable butterfly habitats. Even though the Western Washington open spaces came about largely through human agency, impacts of a greater magnitude could alter them again so that neither immigrants nor the generalists and few specialists already there would find them suitable. For example, the lush Green River Valley south of Seattle has become largely built up, paved or industrialized in the past two decades. Such is the case in more diverse butterfly habitats elsewhere as well.

The premise of this paper is that study of butterfly distribution should furnish indications for nature reserve planning which should result in the retention of regional diversity. In the discussion which follows, each of the butterfly provinces will be considered with such indications in mind. The kinds of decisions in land planning which seem indicated by the data will be suggested. The goal of nature conservation in general and Lepidoptera conservation in particular is not just retention of each named species, but preservation of a range of the characteristics expressed in the various genomes within each species. In other words, distinctive populations at the subspecies level, and unnamed major populations which differ from the typical form of the species to which they belong, are considered to be worthwhile to perpetuate through reserve management. Therefore the priorities mandated by this study for regional diversity conservation should be thought of in conjunction with site-specific, species- and population-specific conservation opportunities.

Conservation priorities. The figures in Table 2 suggest a certain basic ordering of priorities for future reserve planning in Washington. If the assumption is made that all regions of distinct biogeographical affinity should be proportionately represented in the nature reserve system, then it can be seen that a great disparity exists in the preservation of Washington's butterfly provinces. Elwha Province is extremely well represented with 57 percent of its land in reserve status; while Deschutes Province contains reserves equalling only 18 percent of its total area. One must ask why such a difference exists, and in this case the answer is apparent: Elwha Province contains a vast, remote, scenic mounain range which is virtually all set aside in Olympic National Park; Deschutes Province consists of prime agricultural land with many settlements. Even if parity in habitat reserves cannot be reasonably expected among the provinces because of physiographic and demographic reasons, one intelligent approach for managers and conservationists to take would be to work for more reserves in those provinces with the fewest acres (proportional to their size) devoted to this purpose.

Not every acre of a province is the same as every other acre, so a direct acre-for-acre approach will satisfy only part of the problem of diversity conservation. Once having decided which distinctive biotic portions of the state are most poorly represented in nature reserves, one can begin to examine them for biological conservation opportunities. Taking both representation and opportunities together, one can then assign conservation priorities in the most informed manner. Reserve representation is summarized in Table 2. Specific Lepidoptera conservation needs and opportunities follow.

1. *Pend Oreille Province.* Pend Oreille and northern Spokane Counties enclose outliers of the Selkirk Mountains, a range which belongs to the Northern Rockies. This unusual area, with quite high diversity and some state-level endemism among mammals, is the second most poorly reserved province in the state. The Salmo River is a major riverine corridor from the Selkirks into extreme northeastern Pend Oreille Province. A Wilderness Area has been proposed for this area within Kaniksu National Forest. An alternative management suggestion has been a logging road into the Salmo to facilitate timber harvest. Since the area is the least known entomologically in the state, and since reserve representation is so low in this province, the wilderness proposal is an outstanding opportunity for biological conservation and preservation of future research options.

Oarisma garita and *Polites mystic* are two skippers which very rarely, if at all, occur in Washington outside the Pend Oreille. A survey of their habitats and creation of one or more reserves for them would be measures specifically useful for conserving the nature of this unique part of the state. One site from which *O. garita* has been recorded is Mt. Spokane. This isolated mountain, which many consider to be the southernmost of the Selkirks in Washington, supports an extremely interesting butterfly fauna. In addition to the Garita Skipperling, this fauna includes a widely disjunct colony of *Oeneis chryxus* as well as other truly alpine butterflies at their southeasterly extreme in Washington. Mt. Spokane is partly within a state park; however, it is not one of the parks classified by the state as a State Natural Area. Mt. Spokane State Park contains a winter sports area and other facilities. Evaluation of remaining natural habitat in and around the park for possible State Natural Area establishment is a very high priority which can be specified for Pend Oreille Province. Recently D. Frechin (pers. comm.) indicated that the winter sports development may have already extirpated *O. chryxus* from Mt. Spokane.

2. *Spokane-Palouse Province.* From the Spokane River on the north to the Palouse River on the south lies a plateau of rather moist Ponderosa Pine uplands and shortgrass prairies. Several butterflies often thought of as montane occur here, but the area lacks the alpine elements which distinguish both the Pend Oreille on the north and the Blue Mountains on the south. It is clearly different from the Columbia Basin, however, into which it blends on its western edge. Nearly 20,000 acres of the lake-studded northern part of the province have been set aside in Turnbull National Wildlife Refuge, and this reserve has been far too little studied entomologically.

Unusual concentrations of butterflies occur on Steptoe Butte in the southern part of the province. This well vegetated prominence rises above both agricultural influences and greater aridity around it. Steptoe Butte lies within a state park, but again this has not been designated as a natural area by the State Parks and Recreation Commission. In view of the low proportion of this province in reserve status, and virtually all that being of one type, it would seem advisable for the Commission to review this area for greater policy safeguards. Such is necessary within state parks, because management varies from benign neglect to total transformation of the land into human-service areas. These recommendations are made in order to help assign high-density facility developments to areas where they will do least damage to significant biological resources.

Information is not available from this study to suggest further specific management priorities in the Spokane-Palouse Province,

except to recommend that shortgrass prairie environments are among the most poorly represented habitats in the state reserve matrix. I believe that further opportunities for prairie nature reserves should be diligently sought within this province by the Washington Natural Heritage Program and others.

3. *Snake Province*. Biologists tend to consider the Blue Mountains themselves, which protrude only a short distance into Washington and occupy less than one-quarter of this province, as a separate biotic unit. In a sense they are, as the presence of *Lycaena editha* only within the mountainous part of the province would seem to indicate. However, many of the butterfly species typical of the Blue Mountains range north to the Palouse River, or at least to the Snake River, as well. It seems most logical to treat not only the dissected plateau of the Blue Mountains, but also its grassland hems, as a single biotic region. It is a region substantially changed since human settlement, although not heavily populated. Riparian and canyon habitats have been inundated by dams on the Snake River, grasslands cultivated and the Blue Mountains heavily grazed. Nevertheless, this province exhibits high diversity (99 species) and has proportionately more of its land reserved (3.65%) than either of the other eastern border provinces. Even so, striking opportunities for Lepidoptera conservation remain unfulfilled in the Snake Province.

Parnassius clodius shepardi Eisner is one of the several outstandingly disjunct taxa of butterflies which fly in the Snake Province, with no conspecific populations intervening between there and the Cascades, the Selkirks or the Rockies. *P. c. shepardi* is also a distinctive insect in facies, larger and darker than other subspecies. Its type locality, Wawawai, in the Snake River Canyon, has been inundated by a reservoir. As far as I know, no Washington specimens have been collected since that happened, and it is conceivable that this unique taxon is extinct in the state. One of the most notable endemic butterfly subspecies in the region, and therefore an excellent indicator of the kinds of ecological conditions unique to the Snake system, Shepard's Parnassian should be a strong priority for conservation if in fact it still occurs in Washington. Recent Congressional establishment of a Hells Canyon-Snake River National Recreation Area in Idaho, Oregon and Washington assured that the remaining free-flowing Snake upstream of Clarkston will not be dammed, as has long threatened. Clarkston is only about 25 miles from Wawawai, so the chances of *P. c. shepardi* occurring within the new reserve are substantial. However, national recreation areas in themselves were not judged to be sufficiently protected for inclusion in the nature reserve compilation made for this study, since the management policy for this federal category permits development of intensive recreational facilities as well as a certain amount of resource extractive use. For the conservation of Shepard's Parnassian and the rest of the distinctive Snake River fauna, it will be crucial that the Hells Canyon-Snake National Recreation Area have emphasis placed on biological conservation in a strict sense in its management plan. *Dicentra* spp., the host plant of the parnassians of the Snake Canyon, grow in sheltered areas and should withstand mild receational use of their habitat. However, the full requirements of *P. c. shepardi* should be studied and provided for in the management plan.

The Snake River is a major biogeographic corridor from the Rocky Mountains, as its tributary the Grande Ronde serves as a biotic conduit from the northern Great Basin country of Eastern Oregon. This was substantiated in July, 1975, when I collected the first Washington specimen of *Nathalis iole* in this canyon (others were collected by Sarah Hughes and D. P. Shaw; a total of seven fresh males). A major range extension northward and westward, the record did not represent a permanent addition to the fauna since *N. iole* is a northward migrant each spring, apparently seldom reaching this latitude. Its presence did, however, confirm the anticipated biological interest of the canyon, which (with the Snake, near their confluence) supports some of the only stands of *Celtis reticulata* trees in the state. Happily the Grande Ronde will be maintained in a free-flowing condition by the same National Recreation Area mentioned above, and adjacent uplands are set aside in state wildlife recreation areas. Additional reserve opportunities exist nearer the Oregon border. Further faunistic research here would be productive, as it would in the above-mentioned Salmo River in the Pend Oreille—both of these corner-cutting streams are important connectors to very different biological regions.

The river canyons are only one of the distinctive environments in the Snake Province. The region is best known for the Blue Mountains. Many butterflies are shared between the Blues and the Cascades, the Olympics and the Okanogan. However, few of the inter-mountain populations are peripatric, and a number of them are different at the subspecies level. The Washington Blue Mountains have none of the arctic-alpine peaks found in the main body of the range in Oregon, particularly in the Wallowa Mountains. Although lacking in truly alpine character, a substantial tract of arid-transition and lower montane wilderness has been set aside as the Wenaha Back-Country Area within Umatilla National Forest. *Lycaena editha, Speyeria egleis*, various intriguing hairstreaks and other characteristic Blue Mountain butterflies should be well protected within this reserve; nonetheless, since the rest of the area is fairly heavily used for various purposes including grazing and timber production, a thorough butterfly survey keyed to a management plan would not be redundant here. "Back Country Area" is a Forest Service classification, changeable by policy decision. Congressional consideration of the area as a part of the federal wilderness system is another management alternative in this province.

The Pataha Bunchgrass Federal Research Natural Area (Franklin, *et al.*, 1972) reserves a small amount of the ecotonal grasslands between the Blue Mountains and the shortgrass prairies of the northern part of the province. In my field work I found that this reserve supports all three species of *Cercyonis* which occur in Washington, indicating a relatively undisturbed site, since the three are not frequently sympatric. As for the prairies, most of these have long since been converted to wheatlands or been altered by grazing. Two small grassland reserves are owned by Washington State University. Collectors from this institution long ago took several species in the vicinity which have not recently been recorded in this part of Washington, notably *Polites sonora* and *Boloria bellona*, both very far to the southeast from any other known populations in Washington. Whether they are now extinct in the area is not known. Paradoxically, the modern fauna is not well known in this area which produced much of the early entomological knowledge in Washington. Opportunities for significant habitat conservation in this area occur both in the grasslands and the border outliers of the Moscow Mountains of Idaho. Investigating one such site near Pullman, I found it diverse floristically, although conditions were not right for butterfly flight. Shrubby prominences exist as islands among the wheat monoculture (the one I examined was dominated by *Crataegus*, with *Lupinus* in the understory). One of the largest of these hills is Kamiak Butte.

Like Steptoe Butte and Mt. Spokane in the provinces to the north, Kamiak is a state park without a declared natural area; like them too, Kamiak Butte is known in the area for its butterfly richness.

4. *Okanogan Province.* The old (partly Pre-Cambrian) and geologically complex Okanogan Highlands share some affinities with both the North Cascades and the Northern Rockies. That this region exists as a distinct physiographic and biotic unit is generally agreed upon, but its definition varies among authors. Some extend its western limit to the Cascade Crest, while others incorporate the Pend Oreille on the east into the Okanogan. As my figures show, the central Okanogan Highlands (from the Okanogan River east to Pend Oreille County) are distinct from both the Northeastern Cascades and the Pend Oreille. Even thus narrowly defined, it is a large province with 10 percent of the state's land. Little more than one percent of the province is managed expressly for nature conservation. Most of that (40,861 acres) is in Little Pend Oreille National Wildlife Rufuge and consists of low valley and riparian habitat quite unlike the uplands which comprise much of the province.

The Eastern Tiger Swallowtail (*Papilio glaucus*) exemplifies the boreal Canadian faunal element which makes its presence known to naturalists in the Okanogan. Lepidopterists frequent accessible parts of this territory in pursuit of a number of uncommon Washington butterflies including *Boloria selene, Speyeria atlantis* and *Harkenclenus titus*. Near Republic in Ferry County, in 1975, I found a disjunct population of *Boloria bellona*, a part of a rich butterfly fauna in an area with no dedicated reserves. The Army Corps of Engineers' *Washington Environmental Atlas* (1974) indicates a large acreage in the Okanogan Province, in several parts, consisting of *de facto* wilderness. Perhaps the outstanding opportunity for Lepidoptera conservation and nature conservation on the whole in this region would be for the enactment of wilderness legislation officially dedicating some of these tracts to roadless purposes.

5. *Columbia Province.* The almost seven and one-half million acres of the Columbia Basin support several shrub-steppe communities (Franklin and Dyrness, 1973) most of which have been altered by farming and grazing. Many of the species characteristic of the sagelands and grasslands of the Basin also occur in the lower edges of the adjacent provinces, but the reverse is not true. The province is more distinctive for its lack of montane butterflies than for its own endemicity, although it does have its own butterfly association which includes *Heliopetes ericetorum* and several pierines. The two butterflies most strongly associated with the Basin are both riparian species, each occupying a different kind of habitat along the major rivers of the province—the Columbia, the Snake and the Yakima. *Limenitis archippus* occurs in willow thickets along river shorelines and deltas, since it feeds on *Salix* spp. *Papilio oregonius* flies in the basalt canyons which favor its host, *Artemisia dracunculus*.

With 377,308 acres of habitat set aside in a local, state and federal network of 23 reserves, the Columbia Province would seem to have an adequate reserve investment. Such an assumption can only be made with two qualifiers. First, the majority of the land reserved lies within the Hanford Plant of the Atomic Energy Commission. Should that agency's policy toward inter-agency agreement change, and the state wildlife recreation area and national wildlife refuge therein be otherwise classified, the entire reserve complexion of the province would be altered. The 75,000 acre Rattlesnake Hills Federal Research Natural Area managed by the AEC on the west side of the Columbia River (the opposite slope from the other reserves) seems to be firmly dedicated to nature conservation, as do the wildlife refuges. The second qualifier concerns the river itself. The final 41 miles of free-flowing, non-tidal Columbia River in Washington flow through this province between McNary and Priest River Dams. Should the proposed Ben Franklin Dam materialize, this stretch would be inundated. It is on the banks of this section of the river that the large reserves mentioned above are situated. None of the other land reservations in the Basin furnish the highly diverse and productive riparian situation which characterizes the Columbia where it flows freely. The adequacy of nature conservation in the Columbia River region hinges on the retention of this stretch in its unimpounded state.

Both of the butterflies referred to above as Columbia Basin indicator species have undergone sizable range reductions due to human impact in Washington. Hopfinger (unpul. ms., 1956) stated that *L. archippus* was common in the northern Columbia Basin at Brewster in 1916, but that orchard spraying since then had eliminated it from the vicinity. Today it may be found in the Columbia Park in Kennewick. Amenity reserves currently under consideration for the lower Yakima River Valley have an opportunity to protect additional habitat for this now uncommon butterfly by preserving riverside willow thickets. As for *P. oregonius*, much of the steep coulee habitat where it abounded previously has been inundated by 15 dams on the Columbia and Snake Rivers in Washington. Clearly the highest priority for the conservation of this endemic Northwest swallowtail is natural river status for the remaining segment of the Columbia River which qualifies.

6. *Yakima-Methow Province.* This biotic unit covers more than one-fifth of the state, furnishes habitat for more than nine-tenths of its butterfly fauna, and encloses nature reserves of many kinds (32 in number) which comprise 13.77 percent of its overall area. While this might seem more than sufficient when compared with the other provinces, an observation should be made here which applies equally throughout the state. No matter how much land has been formally dedicated for purposes of conservation, important habitats may be excluded. This province furnishes an excellent example of that principle. In the Yakima Valley, which blends from this province into the Columbia Basin, lies Moxee Bog—one of the only areas in the state set aside largely as a rare butterfly reserve. *Boloria selene* occurs prolifically in this sage desert seep as a probable post-glacial relict, but flies nowhere else in the county. A very few populations occur farther north in the province, but none of these are protected. Therefore, the entire million and a half acres of habitat reserves in the Yakima-Methow Province would not be really "adequate" minus the 14 acres at Moxee Bog, set aside by The Nature Conservancy. Another example, the large clover *Trifolium thompsonii*, is strictly endemic to Swakane Canyon in Chelan County, Yakima-Methow Province. The Swakane State Wildlife Recreation Area protects this wildflower; none of the other extensive state wildlife areas in the province have that capacity. Further opportunities exist for specific management of this sort. In the southern part of the province, *Hesperia nevada* is known from two sites only in the higher elevations of Yakima County; neither is a reserve. The site of discovery of the butterfly in Washington by Jon Shepard, Blue Slide Lookout, is on Forest Service land; the other colony, found by E. J. Newcomer, occurs on Signal Peak on the Yakima

Indian Reservation. The latter site also supports one of the few mountain colonies of *Polites mardon*, and presents the Yakima Indian Nation, through its tribal council, with an excellent opportunity for butterfly conservation.

The number of arctic-alpine and boreal butterflies which insinuate themselves into the north-central part of the state, each in just a few known localities, suggested the separation of a distinct North Cascades Province. As shown earlier, this was attempted, but it was not supported by the faunal resemblance test. The great majority of species (nearly 100) can be found in each of three canyons—Black Canyon in the North, Tumwater Canyon in the middle, and Bear Canyon in the South—rendering the overall resemblance throughout the Yakima-Methow region too great for inter-distinction. Nonetheless, this northern element is of great interest and suggests certain reserve priorities.

Four of the northern intrusions into Washington occur within the Pasayten Wilderness Area—*Lycaena cupreus, Colias nastes, Boloria astarte* and *Oeneis melissa*. Two of the others, among the rarest butterflies in the state, fly within no dedicated reserves, to my knowledge. *Pyrgus centaureae* is known only from Cooney Mountain in Wenatchee National Forest (also the southernmost locality for *O. melissa* in Washington). *Boloria freija* has been found only in a few meadows in the high country near Winthrop in the Okanogan National Forest. Forest Service officials should consider designating these sites as natural areas, as they have done for several outstanding botanical communities elsewhere in Washington State. There is no known present threat to these uncommon butterflies, but a principle adhered to throughout this paper is that the *status quo* is no guarantee of conservation; actual designation of an area as a reserve is necessary to guarantee that incompatible management decisions will not inadvertantly be made at a later date.

7. *Nooksack Province*. An intuitive decision to segregate this northwestern area from the rest of the North Cascades, central foothills and Puget Sound Trough was corroborated by the faunal resemblance figures. *Betula papyrifera* is entirely restricted to the lowlands of this province in Washington, while *Erynnis pacuvius, Nymphalis vau-album* and other boreal butterflies occur here with greater frequency than in other provinces.

The eastern third of the province has been preserved in the north unit of the North Cascades National Park. Mt. Baker and its vicinity increased the area effectively set aside, but the Mt. Baker National Recreation Area was not included in the reserve tabulation for reasons given above in the discussion of National Recreation Areas. Nonetheless, conservation opportunities exist still in the foothills and lowlands of this unit. Huxley College, the environmental studies institution within Western Washington State College at Bellingham, could conduct a habitat survey of Nooksack Province with the goal of adding to its modest number of ecological study areas. An active shoreline conservation program is taking place on the Nooksack coast (Roger Almskaar, pers. comm.), but, as with the rest of the state's coastline, difficulties in computing acreage of shoreline conservancy districts led to their exclusion from the reserves scan in this study. Flood plain open country in the Nooksack Valley, as well as numerous freshwater wetlands which are beginning to be impinged upon by extensive recreational and residential development, offer obvious priorities here. The extensive dairy and other agricultural land in the western Nooksack Province consists of secondary habitat which I found fairly suitable for butterfly colonization. If the Chuckanut Mountains locality for *Mitoura spinetorum* is still extant (J. F. G. Clarke collected the butterfly there many years ago) it should be investigated for possible reserve status, as it is the only record for Western Washington away from the Cascade Crest.

8. *Snoqualmie Province*. While many butterflies straddle the Cascade Crest, others observe it as a barrier. For example, most of the hairstreaks of the genus *Satyrium* follow the eastern Cascades (Yakima-Methow Province) north, but do not cross the crest to the west. Mt. Rainier and Glacier Peak lie in this province. The other Cascade volcanoes, Mt. Baker in the Nooksack Province, Mt. Adams in the White Salmon Province and Mt. St. Helens in the Cowlitz Province, seem to have somewhat different biogeographical affinities. Mount Rainier National Park is a large factor in the 15.5 percent of the Snoqualmie Province which is reserved.

I know of no immediate species-specific conservation priorities in the Snoqualmie Province at this time. However, one of the major goals of biological conservation, along with preserving taxa themselves, is preserving research opportunities. No full assessment can be made of conservation needs in a region until at least some field work has been undertaken. In this area, there exists a very large and geographically distinctive area where virtually no lepidopterological field work has been carried out. This is the Alpine Lakes Plateau, a broad, high alpine expanse with many lakes and open meadows. A reasonable guess is that the butterfly fauna should be rich, and there may even be postglacial relict demes which are unsuspected. This alpine wilderness holds the answers to intriguing questions of butterfly biogeography, one of which is this: Where is the southern limit of the range of *Erebia vidleri*? This butterfly has been taken on the northern edge of the Alpine Lakes Plateau, at Stevens Pass; but not to the south of the wilderness. What is the barrier, and where does it fall? Satisfaction of entomological curiosity about the Alpine Lakes awaits exploration. Whether the area is to be sampled in an unaltered state is in question, since mining and logging interests are competing with a wilderness lobby for the plateau. An Alpine Lakes Wilderness bill is before Congress at this writing. Its passage can be said to be an outstanding priority for the retention of basic faunistic research potential in Washington State.[3]

9. *Cowlitz Province*. A rather poorly differentiated province isolated from either main Cascades or Puget Basin influences, this province has been heavily logged. Most of the 3.49 percent of its area which can be counted as reserved is accounted for by the Goat Rocks Wilderness Area. Future options in the province include additional wilderness designations of areas such as the Mt. Margaret back-country north of Mt. St. Helens, and natural area designation of smaller sites in the Mt. St. Helens region. This is the only one of the Cascades volcanoes in Washington which has not had a representative part of its area set aside in a protective category (see footnote below).

Mt. St. Helens has been considered depauperate by lepidopterists; indeed the entire province seems that way from my records. I suspect this is partly true and partly an artifact of undercollecting. Efforts to sample new locales in 1975 were defeated by constant rain. I know of no pressing butterfly conservation needs in the province; intensified field work is needed. The lowlands of Cowlitz Province have almost no reserves.[4]

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[3]Since this paper was completed, an Alpine Lakes Wilderness Area has been established. Its acreage is not reflected in the reserve totals.

[4]Clearly, all remarks concerning Mt. St. Helens are now obsolete, as this paper was completed well before the 1980 eruptions. A subsequent paper will examine effects of the volcanic activity upon butterfly populations and distribution.

10. *White Salmon Province.* More distinctive and more diverse than the preceeding province, this region supports more butterfly species than any other in Western Washington. Many of these occur in the Mt. Adams and western Klickitat County areas, which might arguably have been incorporated into the Yakima-Methow Province. However, the east-west barrier breaks down between Mt. Adams and the Columbia River, and the composite range map suggests this arrangement. Again, a large wilderness area in the eastern uplands of the province, this time the Mount Adams Wilderness, supplies the bulk of the reserved land in the province. Two other parts of the region particularly warrant examination for further reserve establishment, from a Lepidoptera conservation standpoint.

In the southwesternmost extension of the Cascade Mountains in the state, Paul Handy (pers. comm.) has found some highly disjunct butterfly populations. These include *Carterocephalus palaemon* and *Colias occidentalis*. The collecting sites, Larch Mountain and Lookout Mountain in the Gifford Pinchot National Forest, have yielded together a higher diversity of mountain butterflies than any other locale south of Mt. Rainier in Washington, with the possible exception of Mt. Adams. The Forest Service should consider this in formulating land-use plans for the vicinity.

The lowlands of Clark County, chiefly agricultural flood plain in the bend of the Columbia River, are represented in no nature reserves.[5] Floristically distinct in Washington, this part of the White Salmon Province contains much more Oregon Ash (*Fraxinus latifolia*) than most other parts of the state as several stands of Chinquapin (*Chrysolepis chrysophylla* (only in the eastern part of the province)) which otherwise grows only in disjunct Mason County stands. Chinquapin is a host plant for *Habrodais grunus*,a western hairstreak known in Oregon and which I anticipate will be discovered in the White Salmon Province in Washington.[6] At least one butterfly is already known to occur here and nowhere else in the state, this being *Adelpha bredowii*. Paul Handy has collected a number of uncommon skippers among the lowland communities here including *Euphyes vestris* and *Polites sonora*. This suggests that potentially rich reserve sites may still be available, although two searches of my own in the area indicated that few uncultivated areas remain. Establishment of a sizeable nature reserve in the Clark County shrub-grassland flood plain, which one hopes would contain populations of several of the distinctive butterflies of the area, is a recognizeably high priority for Southwestern Washington. It might best be pursued by the nearest chapter of the Audubon Society; local chapters of this private organization have been active in identifying important wildlife resources in their areas. The rapid land development in rural Clark County and the Vancouver metropolitan area makes this a goal which should be pursued as soon as possible.

11. *Deschutes Province.* Like the foregoing province, this region contains some of the few long-term open habitats in Western Washington. These are the so-called Puget Prairies, Tenino Prairies or Mima Prairies on the gravelly, glacial outwash plains south of Puget Sound. I had previously allied these grasslands with the White Salmon Province lowlands (Pyle, 1974). They are quite different, as this study reveals, their faunal similarity being only 45.28 percent. The investigation also shows that this province is not only richer than other Western Washington low country, but also the most poorly reserved province of all (0.18 percent). Scenically and geographically noted for the Mima Mounds formation and biologically for the many plants and animals which flourish on the praries, Deschutes Province nevertheless has been cultivated or developed in large measure. Presenting settlers with natural farmlands, the prairies probably would have been entirely plowed if not for the obstruction of the mounds. Human pressures are intensifying on the small overall area of Deschutes Province today, so that opportunities for an integrated system of reserves on its nine-tenths of a million acres may not be available for long, if indeed they still exist at all. Only 1,631 acres are currently reserved, by the Washington Department of Game, The Nature Conservancy and the Department of Natural Resources.

Most of the butterflies characteristic of the province fly within the extant reserves, such as *Euphydryas editha* and *Incisalia polios*. However, the great (for Washington) variety of skippers recorded from the "Tenino Prairies" by many collectors over the years is not fully represented, and a broader coverage of the Puget grasslands by nature reserves seems necessary to insure that this variety will be maintained. *Polites mardon*, for example, occupies no known reserve in the area, although Rocky Prairie in this province is the classical locale for it. One of the goals set for itself by the Northwest Lepidoptera Survey (see below) is a thorough survey of surviving prairie habitats in Western Washington. Once the best of these have been identified, the Xerces Society (with the cooperation of the State Natural Areas Committee, The Nature Conservancy, the Washington Natural Heritage Program, the Department of Natural Resources and local Audubon chapters), intends to pursue establishment of more reserves. I consider this to be one of the most important nature conservation priorities in the state.

12. *Willapa Province.* Essentially a vast, dense forest, open only along the coast and where cleared, Willapa Province is in itself one large barrier to butterflies. Faunistic research and conservation are both more potential than realized here. The fact that certain uncommon butterflies such as *Polygonia oreas* have been taken in the woods indicates that the seemingly depauperate province bears further investigation. In particular, I have long wondered whether the Willapa Hills, Washington's end of the Pacific Coast Ranges, contain any balds or meadows which may harbor heretofore undiscovered butterfly populations. If such areas exist (and recent information (K. Maxwell, pers. comm.) suggests they do), they have not yet been sampled. In fact, one of the counties in which they may occur, Wahkiakum, is the sole county in Washington from which not a single butterfly record has been gleaned.[7] Collectors, expecting little return on their effort, ignore these deeply wooded and logging-scarred hills for more predictably productive habitats. Most of the Willapa Hills, and the southern foothills of the Olympics which also fall within this province, are devoted to timber and pulp production. The opportunity exists for private timber companies, the Department of Natural Resources and counties to inspect their expansive forests for pockets of unusual habitat which might be set aside from production—bogs, balds and riverbars among them.

The low figure of 0.81 percent of land reserved for purposes of nature conservation in the Willapa Province should be enlarged. Fortunately, the most important terrestrial habitat in the province, Leadbetter Point, is part of the Willapa National

[5]Ridgefield National Wildlife Refuge was inadvertantly omitted from this study.
[6]This has since been accomplished. Details will be given in a later paper.

[7]This has since been remedied in good measure, see footnote 1.

Wildlife Refuge. This wilderness of dunes and grasslands is depauperate of butterflies by California standards, but this picture may improve when more collecting is done in fair weather. Following a day of extremely foul weather on Leadbetter Point in July, 1975, a warmer, sunnier morning produced three new species records for the area in a very short time, including *Papilio zelicaon*. Existing management policies for Leadbetter Point should be adequate to protect whatever Lepidoptera resource will eventually be found to occur there.

Farther south on Leadbetter Point, a discrete and important butterfly conservation priority has been identified during this study. *Speyeria zerene hippolyta* Edwards is a fritillary which has been considered endemic to the salt-spray meadows of Oregon (McCorkle, 1975). This taxon was proposed for listing as Threatened or Endangered by the Office of Endangered Species, U. S. Fish and Wildlife Service.[3] A series of *Speyeria* collected by me at the Lake Loomis State Fishing Access site on the Long Beach Peninsula in August, 1975, have been determined as *S. z. hippolyta* by David McCorkle, authority on the taxon. This represents a re-discovery of the butterfly in Washington, thought extinct in the state for a quarter of a century. McCorkle suggested (*in litt.*, 31 December 1975) that the population may likely be breeding nearer the coast (c. one km. west) and frequenting the woodland clearing where I found them as an adult rendezvous or feeding station. The Lake Loomis site is on state property, but private land intervenes between there and the coast. A recommended priority for the non-hunted game program within the Department of Game (which has legal jurisdiction over invertebrates) would be location of the breeding ground and acquisition of a reserve, if necessary; and development of a suitable management plan to maintain the present conditions around Lake Loomis where the butterfly occurs at least in the adult stage.

13. *Bogachiel Province.* This, the region of the so-called Olympic Rain Forests, constitutes the cellar of Washington butterfly diversity, with only 11 species recorded (1976). The cool, foggy coast has not yet demonstrated much potential as a movement corridor, except for a single record of a migrant *Cynthia cardui* which I collected near Sand Point. Woodland nymphalines and *Pieris napi* have adapted to the rain forest edges, but few other butterfly species may be encountered here. Thus it was surprising to me when Sarah Hughes discovered *Lycaena mariposa* in the one large clearing in the northwesternmost forests of the state (aside from recent logging clearcuts), a site I had included on our field work itinerary because it had long intrigued me from an entomological standpoint.

Ahlstrom's Prairie lies between Lake Ozette and Cape Alava in Olympic National Park. About 300 acres in extent, this opening is said by the Park Service to have been burned by the Indians to promote the growth of bracken fern as a food source, and later by Lars Ahlstrom, a homesteader. Walking over the prairie in 1975 I found remnants of an old orchard which may have dated from the homestead, which was only abandoned in the 1950s. The actual origin of the "prairie" is in question: bog plants such as sundew (*Drosera* spp.) occur in the wetter, lower parts of the area, but they occur as well in many swampy openings in the Olympic region. I know of no pollen cores which have been done here, nor of any speculation about the prehistory of the site.

Lycaena mariposa is at least 75 miles and 3,500 feet in elevation disjunct here from the nearest known populations in the Olympic Mountains. The only other near-coastal record in Washington was a 1918 specimen, which I have seen in the Washington State University collection, from Ilwaco, an area in the Willapa Province where many boggy areas have since been converted to cranberry farms. As well as being distributionally unique, this Ahlstrom's Prairie population of *L. mariposa* is strikingly distinct in facies from any other Washington material I have seen, in at least three characters. Six males were taken by S. A. Hughes, R. M. Pyle and D. P. Shaw; these are consistent in appearance. They resemble most closely the subspecies *L. m. charlottensis* (Holland) from the Queen Charlotte Islands, British Columbia, where the buttrfly would have evolved under similar conditions of cool summers (the prairie is much cooler than the surrounding forest at night) and extremely high rainfall.

This population of the Mariposa Copper in the Bogachiel Province is the best example I know in Washington of a butterfly serving as an ecological indicator for a unique site. Having evolved such a distinctive form, it is doubtful that the butterfly is a recent, accidental arrival to a secondary clearing from the high Olympic meadows where it is common. Rather, I believe it points to a much longer period of open, boggy conditions at Ahlstrohm's Prairie than has previously been suggested to my knowledge. The host plant of the copper, *Polygonum bistortoides*, does not occur widely near the coast, although its highly dispersive, fleecy seeds might easily colonize available lowland meadows with rapidity from the mountains. But the butterfly is less capable of crossing the thick forest barrier. I hypothesize a former distributional pattern whereby *L. mariposa* occurred rather more widely near coast than it does now, then contracted its range as habitats became less abundant, finally retreating almost exclusively to the high mountains, leaving the Ahlstrom's Prairie population as a relict. This fits rather well with the glacial history of this region. The Vashon Lobe of the Wisconsin Glaciation covered the northern and central Washington coastline and adjacent forest lowlands, but not the Olympic Massif. If alpine glaciers left refugia among the Olympics, as I suspect, *L. mariposa* would at that time have been confined to the mountain refugia. Then, as the continental glaciers retreated, a large mosaic of swamps and potholes would have been left along the costal Bogachiel Province, which *P. bistortoides* and *L. mariposa* might quickly have colonized from the highlands on the East. Later, as the potholes succeeded to bogs and then forest glades and eventually were incorporated into the expanding Olympic rain forest, the Mariposa Copper once again would have been forced to retreat to the mountains. The Ilwaco population discovered half a century ago may have been one of the last remaining colonies at that time; the Ahlstrom's Prairie population may be the final one in the lowlands. I suspect, however, that diligent searching would turn up other colonies, though not many and none as large as that at the relatively extensive Ahlstrom's Prairie. Apparently, the butterfly does not colonize more recent clearings. A boggy clearing just one-quarter mile from Ahlstrom's Prairie had no coppers. Closer examination showed that this 30-acre wet meadow had been a cedar swamp, since sphagnum humps from which Western Redcedar (*Thuja plicata*) trees were sprouting were, in fact, old cedar stumps. I noted no *Polygonum* there.

The significance of *L. mariposa* as an indicator in this case goes beyond speculation in historical ecology. Ahlstrom's Prairie is now succeeding toward forest. Many young cedars

[3]It has since been officially designated as Threatened.

and other conifers are invading the edges and becoming established farther out. The central, boggiest part of the area, the grassiest and most open as well, is beginning to be choked by *Gaultheria shallon* Pursh. It will be necessary for the National Park Service to decide what sort of management, if any, to apply to the "prairie." It could be argued that natural succession should be allowed to occur, and any extinctions which go with it. However, precedent exists in the national parks for management directed toward the maintenance of desirable features which succession threatens to alter. Ahlstrom's Prairie provides an extremely welcome change of aspect for hikers on the popular Cape Alava Trail, and a very interesting research potential for botanists and zoologists. Additionally, the *L. mariposa* deme here is probably the closest thing to a major Washington endemic population in danger of extinction. As such, a viable management plan for maintaining the open character of Ahlstrom's Prairie (as was accomplished by the Indians and by Ahlstrom, perhaps thereby forestalling the extinction of the butterfly colony) is surely one of the foremost priorities to emerge from this investigation. B. Moorhead (pers. comm.) indicated interest and willingness on behalf of the National Park Service to explore this option.

The coastal zone of the Bogachiel Province has been generously reserved in the wilderness coast strips of Olympic National Park and Quinalt Indian Reservation. Interesting habitats inland, such as the one discussed at length above, probably exist among the extensive acreage devoted largely to logging in Olympic National Forest, the Quinalt and Makah Reservations and state and private timber holdings. This part of the Bogachiel Province is little represented in reserves outside the major rain forest river valleys.

14. *Elwha Province.* The high Olympic Mountains comprise a rich island for butterflies among generally depauperate lowlands. Fortunately, more than half of the province (including most of the high country) falls within the 866,655 acres of Olympic National Park and a handful of small reserves. Populations of many alpine and arctic-alpine butterflies exist here, disjunct and long isolated from conspecifics on Vancouver Island or in the Cascades. Endemic subspecies have arisen, such as *Oeneis chryxus valerata* Burdick, *Plebejus acmon spangleatus* Burdick and *Parnassius phoebus olympiana* Burdick. The case of *O. c. valerata* caused concern because of its extremely limited range, and studies on this taxon were carried out in conjunction with this paper. The issue of Valerata Arctic conservation is discussed thoroughly by Pyle (1976a), but not here since the resolution of the situation indicated that it does not constitute a priority at this time. Olympic National Park policies and visitor use patterns suggest the butterfly is safe. In fact, with the exception of the proposed addition to the park of mountains facing on Hood Canal, conservation of the butterflies of the Olympic Mountains seems to be essentially a *fait accompli*. Such an addition is recommended.

Included within Elwha Province, however, is a sub-region which might well qualify for a distinct province were it not so small and restricted faunistically. Botanically, the Olympic rain shadow (or Sequim rain shadow) certainly is distinctive. The entomological evidence in my possession merely suggests that it is an interesting, relatively arid edge of Elwha Province. Nevertheless, another case of a butterfly population serving as an excellent indicator of site specialty was discovered here. Visiting the Dungeness Recreation Area east of Port Angeles in Clallam County, my party was about to descend on the trail to Dungeness Spit on the Straits of Juan De Fuca, when the habitat at the trailhead struck me as unusual. I had previously collected *Euphydryas editha* and *Papilio eurymedon* on a different part of the Dungeness Bluffs, but the aspect here was entirely different.

The situation at the Dungeness Bluffs appears to me to have originated from stabilized headland dunes, at the interface between Sequim Prairie (mostly agricultural) and the narrow band of forest above the coast. This hilly, sandy landscape supports a scrubby vegetation unlike any other community I have ever encountered in Washington. It can best be described as a sort of a shrub-heath, dominated by Manzanita (*Arctostaphylos columbiana*) bushes and Ocean Spray (*Holodiscus discolor*) bushes, with *Castilleja* spp. and other flowering herbs common at the ground level. Franklin and Dyrness (1973) made no mention of this association in their extensive treatment of the vegetation of Washington and Oregon. The unusualness of the site seemed clear enough from a cursory floristic examination; but the butterfly fauna of the area, although limited on that occasion in July, 1975 to one species, strongly confirmed that impression. David Shaw collected a male specimen of *Colias occidentalis*, and subsequently I took several examples of both sexes. Scudder (1862) described this sulphur from the Gulf of Georgia, which may mean that the type specimens came from Northwestern Washington or Southeastern British Columbia. *C. occidentalis* is basically a northwestern butterfly, not uncommon in the Cascades as far North as Okanogan County, and in the higher Olympic Mountains. A very few populations have been known from time to time along Hood Canal in the Puget Sound Trough. However, no specimens have been taken near the Straits of Juan de Fuca/Gulf of Georgia in Washington prior to our recent capture, unless Scudder's material (from Agassiz) was in fact from there. It seems likely, therefore, that this population may represent the nearest known colony to the type locality. Certainly it is widely disjunct from the nearest populations in the Olympics to the south, by some 20 miles, 4-5,000 feet in altitude and a broad gap of unsuitable habitat.

Conservation of the shrub-heath habitat which supports this remarkable colony of the Western Sulphur is an outstanding priority for the Elwha Province. Three jurisdictions are involved—Clallam County Parks, Washington State Department of Game, and the Bureau of Sport Fisheries and Wildlife. The Xerces Society has been active in congealing their management interests on behalf of the site, and notable success in this has been met.

15. *Duwamish Province.* The Puget Sound Trough and adjacent lowlands and foothills make up this province. Considered poor for butterflies by many lepidopterists, the province actually contains 40 percent of the state's species, including some quite local demes such as *Speyeria leto pugetensis* Chermock and Frechin. On a site-to-site basis, however, much of the province typifies the "depauperate Western Washington" condition discussed above.

Interestingly, the province which includes the major industrial and population centers of Seattle and Tacoma has the highest number of nature reserves and parks managed for passive, habitat-oriented uses. This array totals, however, the third lowest percentage of land so reserved (54 reserves, 0.39 percent of the province). If the idea that diversity should be conserved not only in remote areas but also near the population centers where it can be observed is a valid one, then the nucleus of little preserves should clearly be augmented as a high state-

level priority. Suggested means of doing so include implementation of large open space zones on the Green River flood plain, a prime agricultural and open space region near Seattle which is rapidly being developed. The Puget Sound Governmental Congress has the jurisdictional means of accomplishing this goal. Enlargement of the Seattle Greenbelt by the city administration and emulation of this tactic by other cities on the Sound would be another approach. The permanent designation of specified portions of undeveloped county parks as natural areas would greatly increase conservation land totals in both King County and Kitsap Counties. In their current "undecided" role, these parks serve habitat needs but their function as such cannot be assumed on a lasting basis.

With specific regard for Lepidoptera conservation, my data do not indicate any reserves in the Duwamish Province which include known habitat of the area's most noted butterfly, *S. l. pugentensis*. Frechin (1949) wrote that populations of this butterfly were suffering from logging of its habitat near Bremerton. Numerous private groups in the Puget Sound metropolitan area, including Seattle and Tahoma Audubon Societies, concern themselves with identification and reservation of significant wildlife resources near the cities. Such activities devoted to the Puget Sound Fritillary and other local butterflies of the basin, among habitats identified by the Northwest Lepidoptera Survey, would make a logical extension of the programs of these groups.

16. *Rosario Province*. Most Washington and visiting biologists, naturalists and recreationists agree that the San Juan Islands present unique opportunities of many kinds. It seemed likely that this archipelago in the Straits of Georgia was a distinct province, and the resemblance data showed that this is true. Bearing extensive stands of Garry Oak (*Quercus garryana*) trees and juniper (*Junipers scopulorum*) shrubs, open, sunny grasslands, and a less humid climate than the adjacent mainland in Washington, the San Juan Islands are extremely appealing esthetically and interesting biologically. Fortunately, they have not been extensively developed. Twenty-seven reserves exist in the islands, under the jurisdiction of nearly every level of government agency and private organization. Even with such collaboration, only about one percent of the land has been formally set aside. A recent survey of natural areas on private lands in the San Juans (The Nature Conservancy, 1975) pointed out many vital places and critical means by which the reserve coverage could be supplemented. The Conservancy itself has been actively pursuing such ends, having recently purchased a large part of biologically rich (and entomologically unexplored) Waldron Island as a preserve.[9]

Two butterflies of special interest in the San Juans are the island population of *Oeneis nevadensis* and a distinctive population of *Speyeria hydaspe rhodope* Edwards. The former is known from no other near-coastal locale in Western Washington; the latter from few locales in Washington State. Both, apparently, have been found near Mt. Constitution on Orcas Island. This area lies within Moran State Park which has not been classified in whole or in part as a natural area by the State Parks and Recreation Commission. Securing known habitat for each within some sort of reserve structure is a high priority for Rosario Province, and the clearest opportunity to do so seems to be the Park Commission's. Supplied with accurate information from lepdiopterists who know the area, the planners could establish a natural area within the park to encompass the habitat.

[9]Since then, Yellow and Sentinel Islands have been purchased.

Summary and Conclusion

This paper developed butterfly provinces for Washington State as representations of the arrangement of natural diversity on the landscape. These units were compared with the nature reserves they contain on an areal basis. It was found that the distinctively different parts of the state vary widely in the proportion of each which is managed for nature conservation. These proportions suggest broad priority rankings for future reserve establishment. The Pend Oreille and Deschutes Butterfly Provinces, in addition to belonging among the most biologically singular parts of the state, are the most poorly represented in natural reserves, with less than 0.2% of each province set aside. In contrast, more than 13% of the Yakima-Methow Province has been reserved for habitat conservation purposes, more than 15% of the Snoqualmie Province, 36% of the Nooksack Province, and more than 57% of Elwha Butterfly Province. Most of the other areas have less than 5% of their area in reserves. The most urgent and obvious priorities for diversity conservation in Washington lie in the Puget Prairies, the Selkirk Mountains, the Palouse grasslands, the Willapa Hills, and the Puget Sound Basin. The adequacy of diversity conservation in the vast, much-altered Columbia Basin depends upon the retention of the last natural stretch of the Columbia River in its undammed condition.

The data also revealed individual species, subspecies and populations of butterflies which warrant habitat conservation attention in Washington. These taxa were discussed with regard to specific land management alternatives and policy approaches, and the appropriate agencies and organizations to do the job were suggested. The only butterfly named by the Department of the Interior for consideration as an Endangered or Threatened Species in Washington, *Oeneis chryxus valerata*, was found to be adequately protected and not in danger at this time. However, *Speyeria zerene hippolyta*, listed as a Threatened Species in Oregon, was found in Washington during the course of this research. The population of this butterfly on the Long Beach Peninsula, in the Willapa Butterfly Province, probably constitutes the outstanding butterfly conservation priority in Washington at this time. Other populations which may require management or at least habitat reservation include a disjunct, newly discovered and highly distinct deme of *Lycaena mariposa* in the Bogachiel Province; an unusual lowland colony of *Colias occidentalis* on the Dungeness Bluffs, Elwha Province; *Parnassius clodius shepardi*, possibly extinct in its type locality on the Snake River; *Speyeria leto pugetensis*, not endangered but certainly reduced due to habitat alteration in the Puget Sound Basin, for which it was named; and the notably diverse assemblage of skippers (Hesperiidae) on the Western Washington grasslands of the Puget Prairies and the open lowlands of the White Salmon Butterfly Province. These kinds of site-specific situations should be considered alongside the diversity-oriented recommendations generated by the study, since management planning based entirely on one or the other would result in an inadequate representation of rare Lepidoptera per nature reserve and of nature reserves per biotic province.

I conclude that butterflies do provide effective indications of both regional diversity and site distinctiveness in many environments. By approaching butterfly conservation in a biogeographical context first, then through specific ecological investigations, one can propose more effective forms of biological conservation than random actions traditionally have brought about. I hope that these results might furnish a paradigm for

other invertebrate conservation and management programs elsewhere in the world. The concept which was applied here is quite simple: *Juxtapose extensive distributional data with comprehensive organizational information to show the relationship between biotic regionality and land management; then go back to the organisms and their habitats on the one hand and to the actual land-use categories on the other, to design a plan for the improvement of that relationship.*

The brush-fire approach to nature conservation has prevailed in the past, largely out of necessity because of a rising local extinction rate. I do not think that application of these techniques will entirely supercede emergency conservation action on a site-to-site basis. But I do think that implementation of schemes such as this one, employing butterflies or other organisms, will significantly reduce the incidence of emergency conservation measures. It can do so by systematically identifying critical future needs on a regional basis, and secondarily by relating those priorities to specific site conditions before threats to such sites arise.

In a sense, then, the paradigm that this study offers is a kind of preventive conservation. Applied widely, not only with Lepidoptera but also with the full array of natural features, the eco-geographic approach illuminates the *opportunities as well as the emergencies*. Coupled with astute political activity, it could result in a much more efficient, less expensive, certainly less contentious and probably more inclusive way of going about conserving nature. If organisms can be maintained for now over substantial portions of their ranges, their premature extinctions might ultimately be prevented.

Acknowledgments

Many persons assisted with this study, and they have been thanked in detail in the original thesis. The pioneering and extensive efforts of the late John Hopfinger and E. J. Newcomer; and those of Ben V. Leighton, J. F. Gates Clarke and Don Frechin, laid the foundation of Washington butterfly knowledge and made this study possible. The largest bodies of data came from Jon Pelham and Jon Shepard, my close colleagues in the Northwest Butterfly Survey, who shared records and spent time generously, according to my needs. Other major contributors of field records included John Hinchliff, Virgil Calkins, Dan Carney, Ed Gage, Paul Handy, Stanley G. Jewett, Jr., Michio Kimura, David McCorkle, Robert Miller, Dennis Paulson, Wesley Rogers, Donna Seaman, Shaundelle Vail, Floyd and Michael van Buskirk, Paul Wiley and Robert Woodley. Many others also furnished field data. Lee Rogers and Paul Handy as well as Washington State University loaned specimens, and John Burns, Dave McCorkle and Kurt Johnson aided with determinations. The following curators and museums indulged me with lengthy access and introduction to their major collections: Charles L. Remington and Dale Schweitzer, Yale Peabody Museum of Natural History; J. F. G. Clarke and William Field, National Museum of Natural History, Smithsonian Institution; Frederick H. Rindge and Eric Quinter, American Museum of Natural History; and Jonathan P. Pelham, Burke Memorial Museum, University of Washington.

Energetic field assistance was lent by Sarah Hughes, David P. Shaw, Howard W. Pyle and others. For collecting permits and extensive information used in the nature reserve analysis, I am grateful to employees and officials of The Nature Conservancy; the U. S. Forest Service, National Park Service, and Fish and Wildlife Service; Washington State Parks and Recreation Commission, Department of Natural Resources and Department of Game; many counties and cities of Washington, and the various Indian tribal councils. Officers of Fort Lewis (U. S. Army) and the Hanford Atomic Reservation also complied with my needs, as did the Army Corps of Engineers. Sydney Gould kindly introduced me to his Geo-Code system, which was thence adopted for the study. Financial assistance was provided by the Yale School of Forestry and Environmental Studies, the Graduate School of Yale University, Sigma Xi (The Scientific Research Society of North America), and the National Wildlife Federation.

Helpful discussion and advice given by Frances Chew, Russell Miller, and Robert Gara, among others, no doubt improved the result. Above all, the constant contributions of my faculty committee must be acknowledged and appreciated. The rigorous but constructive criticism of Charles L. Remington, Richard S. Miller and Lloyd C. Irland shaped the dissertation of which this study was a part. I warmly wish to thank Professor Remington for his continuous encouragement over the past twenty years. His enthusiasm for my interest in Lepidoptera conservation is directly responsible for the initiation of these studies, and his empathy, for their completion.

Sally Hughes performed all the deeds for which spouses traditionally receive acknowledgments, but I would rather thank her for her company, her patience, and for discovering the mariposa copper on Ahlstrom's Prairie.

Dedication

As a step in our growing understanding of Washington butterflies and their biology, I would like to dedicate this study to the memory of two earlier aurelians: John C. Hopfinger and E. J. Newcomer. Their respective attention to the butterflies of Okanogan and Yakima Counties, the two richest counties in the state for butterflies, spanned together over a century of zealous field work. Both men knew no limits to their enthusiasm nor to their kindness for others who shared their interest in butterflies. The joint contributions of John Hopfinger and E. J. Newcomer to Washington butterfly knowledge may never be equalled.

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EDITOR's NOTE:

Since this study was completed, five years of activity have greatly altered the state of both butterfly faunistics and nature conservation in Washington. While the new information may differ in many particulars from that analyzed here, it is not felt that the general trends would differ greatly had it been included. The conservation priorities indicated, and the usefulness of the methods as a model for application elsewhere, should stand. Nevertheless, a complete reanalysis of the data is anticipated in order to test the reliability of the butterfly provinces with enhanced records and to assess the progress in conservation since 1976. Therefore I would be grateful to receive any new or heretofore unincluded information on Washington butterfly and nature reserve distribution; as well as any comments on the study itself. RMP.

A Check List of Washington Rhopalocera[1]

THE EVERGREEN AURELIANS

John Hinchliff, David V. McCorkle, Jonathan P. Pelham, Robert M. Pyle and Jon H. Shepard

1980

Foreword

The following Checklist of Washington Butterflies has been prepared by the Evergreen Aurelians, a team of lepidopterists who have long felt a need to revise and update the last published State List by Ben V. Leighton in 1946.

We are indebted to many collectors who have provided data since the beginning of this century. In particular we wish to thank the following:

A. Anderson	M. Kimura
W. Burdick	B. V. Leighton
F. Van Buskirk	R. Littlefield
M. Van Buskirk	T. Lorentz
D. Carney	S. Mayberry
R. Cheyne	A. Mesford
J. F. Gates Clarke	R. Miller
R. Crawford	R. B. Nagle
T. Davies	E. J. Newcomer
D. P. Frechin	S. Nicolay
E. Gage	J. Pederson
P. Handy	L. Rogers
E. Henrikson	W. Rogers
J. C. Hopfinger	F. Stecker
S. A. Hughes	S. Vail
S. G. Jewett, Jr.	P. K. Willey
J. Justice	R. E. Woodley
T. Kahler	and others.

There are still many counties in Washington that have received little attention from collectors as may be readily seen from the map of known collecting localities—particularly those along the Pacific Coast and the Columbia Basin of Eastern Washington. Any volunteers?

We are presently developing distribution maps for all species and subspecies found in the State. In order to keep these maps and charts as complete as possible we will still need the support of collectors throughout Washington. Additional collecting data will be greatly appreciated. Please send it, including collector's name, date and location (with Town and Range coordinates and elevation if possible) and other pertinent information to Jonathan P. Pelham at the address listed below.

Hesperiidae

Pyrginae

1. *Epargyreus clarus clarus* (Cramer 1779)
2. *Thorybes pylades* (Scudder 1870)
3. *Erynnis icelus* (Scudder & Burgess 1870)
4. *Erynnis propertius* (Scudder & Burgess 1870)
5. *Erynnis pacuvius lilius* (Dyar 1904)
6. *Erynnis persius* (Scudder 1863) 'ssp'
7. *Pyrgus centaureae loki* Evans 1953
8. *Pyrgus ruralis* (Boisduval 1852)
9. *Pyrgus communis* (Grote 1872)
10. *Heliopetes ericetorum* (Boisduval 1852)
11. *Pholisora catullus* (Fabricius 1793)

Heteropterinae

12. *Carterocephalus palaemon mandan* (Edwards 1863)

Hesperiinae

13. *Oarisma garita* (Reakirt 1866)
14. *Hesperia juba* (Scudder 1872)
15. *Hesperia comma* (Linnaeus 1758)
    a. *H. c. manitoba* (Scudder 1874)
    b. *H. c. harpalus* (Edwards 1881)
    c. *H. c. oregonia* (Edwards 1883)
    d. *H. c. hulbirti* Lindsey 1939
16. *Hesperia nevada* (Scudder 1874)
17. *Polites coras* (Cramer 1775)
18. *Polites sabuleti sabuleti* (Boisduval 1852)
19. *Polites mardon* (Edwards 1881)
20. *Polites themistocles* (Latreille 1824)
21. *Polites mystic* (Edwards 1863) 'ssp'
22. *Polites sonora* (Scudder 1872)
    a. *P. s. sonora* (Scudder 1872)
    b. *P. s. siris* (Edwards 1881)
23. *Ochlodes sylvanoides sylvanoides* (Boisduval 1852)
24. *Euphyes ruricola* (Boisduval 1852)
    a. *E. r. ruricola* (Boisduval 1852)
    b. *E. r. metacomet* (Harris 1862)
25. *Amblyscirtes vialis* (Edwards 1862)

Papilionidae

Parnassinae

26. *Parnassius clodius* Menetries 1855
    a. *P. c. claudianus* Stichel 1907
    b. *P. c. pseudogallatinus* Bryk 1913
    c. *P. c. altaurus* Dyar 1903
    d. *P. c. shepardi* Eisner 1969
27. *Parnassius phoebus* (Fabricius 1793)
    a. *P. p. magnus* Wright 1905
    b. *P. p. olympianus* Burdick 1941
    c. *P. p. xanthus* Ehrmann 1918

Papilioninae

28. *Papilio oregonius* Edwards 1876
29. *Papilio zelicaon zelicaon* Lucas 1852

[1]Foreword by Jonathan P. Pelham, c/o Burke Museum DB-10, University of Washington, Seattle, Washington 98195, USA

30. *Papilio indra indra* Reakirt 1866
31. *Papilio rutulus rutulus* Lucus 1852
32. *Papilio multicaudata* Kirby 1884
33. *Papilio eurymedon* Lucas 1852

Pieridae

Pierinae

34. *Neophasia menapia tau* (Scudder 1861)
35. *Pontia beckerii* Edwards 1871
36. *Pontia sisymbrii flavitincta* (J. A. Comstock 1924)
37. *Pontia occidentalis occidentalis* (Reakirt 1866)
38. *Artogeia napi* (Linneaus 1761)
    a. *A. n. marginalis* (Scudder 1861)
    b. *A. n. mcdunnoughi* (Remington 1954)
39. *Artogeia rapae* (Linneaus 1758)

Anthocharinae

40. *Euchloe ausonides ausonides* (Lucas 1852)
41. *Euchloe hyantis lotta* (Beutenmuller 1898)
42. *Anthocharis sara* Lucas 1852
    a. *A. s. flora* Wright 1905
    b. *A. s. stella* Edwards 1879

Coliadinae

43. *Colias philodice philodice* Godart 1819
44. *Colias eurytheme* Boisduval 1852
45. *Colias alexandra* Edwards 1870
    a. *C. a. edwardsii* Edwards 1870
    b. *C. a. columbiensis* Ferris 1973
    c. *C. a. astraea* Edwards 1872
46. *Colias occidentalis occidentalis* Scudder 1862
47. *Colias nastes streckeri* Grum-Grshimailo 1895
48. *Colias interior interior* Scudder 1862
49. *Nathalis iole* Boisduval 1836

Lycaenidae

Lycaeninae

50. *Lycaena cupreus henryae* (Cadbury 1937)
51. *Chalceria rubidus perkinsorum* (K. Johnson & Balogh 1977)
52. *Chalceria heteronea heteronea* (Boisduval 1852)
53. *Gaeides editha editha* (Mead 1878)
54. *Epidemia mariposa* (Reakirt 1866)
    a. *E. m. charlottensis* (Holland 1930)
    b. *E. m. penrosae* (Field 1938)
55. *Epidemia nivalis* (Boisduval 1869) 'ssp'
56. *Epidemia helloides* (Boisduval 1852)

Strymoninae

57. *Incisalia augustinus iroides* (Boisduval 1852)
58. *Incisalis fotis* (Strecker 1878)
    a. *I. f. schryveri* Cross 1937
    b. *I. f. mossii* (H. Edwards 1881)
59. *Incisalia polios òbscurus* Ferris & Fisher 1973
60. *Incisalia eryphon* (Boisduval 1852)
    a. *I. e. eryphon* (Boisduval 1852)
    b. *I. e. sheltonensis* Chermock & Frechin 1949
61. *Mitoura spinetorum* (Hewitson 1867)
62. *Mitoura johnsoni* (Skinner 1904)
63. *Mitoura nelsoni* (Boisduval 1869) 'ssp'
64. *Mitoura siva* (Edwards 1874) 'ssp'
65. *Callophrys dumetorum* (Boisduval 1852)
    a. *C. d. dumetorum* (Boisduval 1852)
    b. *C. d. oregonensis* Gorelick 1969
66. *Callophrys affinis washingtonia* Clench 1944
67. *Callophrys sheridanii* (Carpenter 1877)
    a. *C. s. neoperplexa* Barnes & Benjamin 1923
    b. *C. s. newcomeri* Clench 1963
68. *Satyrium behrii columbia* (McDunnough 1944)
69. *Satyrium fuliginosum fuliginosum* (Edwards 1861)
70. *Satyrium acadica coolinensis* (Watson & Comstock 1920)
71. *Satyrium californica* (Edwards 1862)
72. *Satyrium sylvinus sylvinus* (Boisduval 1852)
73. *Satyrium saepium okanagana* (McDunnough 1944)
74. *Strymon melinus* Hubner 1818
    a. *S. m. setonia* McDunnough 1927
    b. *S. m. atrofasciata* McDunnough 1921
75. *Harkenclenus titus immaculosus* (Comstock 1913)

Polyommatinae

76. *Everes amyntula amyntula* (Boisduval 1852)
77. *Celastrina "argiolus"* (Cramer 1780)
    a. *C. "a". echo* (Edwards 1864)
    b. *C. "a". bakeri* (Clench 1944)
78. *Euphilotes battoides glaucon* (Edwards 1871)
79. *Euphilotes enoptes columbiae* (Mattoni 1955)
80. *Glaucopsyche piasus toxeuma* Brown 1971
81. *Glaucopsyche lygdamus columbia* Skinner 1917
82. *Lycaeides argyrognomon* Bergstrasser 1779
    a. *L. a. ricei* (Cross 1937)
    b. *L. a. atrapraetextus* (Field 1939)
83. *Lycaeides melissa melissa* (Edwards 1873)
84. *Plebejus saepiolus saepiolus* (Boisduval 1852)
85. *Icaricia icarioides* (Boisduval 1852)
    a. *I. i. pembina* (Edwards 1862)
    b. *I. i. blackmorei* (Barnes & McDunnough 1918)
    c. *I. i. montis* Blackmore 1929
86. *Icaricia acmon* (Westwood & Hewitson 1852)
    a. *I. a. lutzi* dos Passos 1938
    b. *I. a. spangelatus* Burdick 1942
87. *Agriades glandon megalo* (McDunnough 1927)

Riodinidae

Riodininae

88. *Apodemia mormo mormonia* (Boisduval 1869)

Nymphalidae

Nymphalinae

89. *Polygonia satyrus neomarsyas* dos Passos 1969
90. *Polygonia faunus rusticus* (Edwards 1874)
91. *Polygonia zephyrus* (Edwards 1870)
92. *Polygonia oreas silenus* (Edwards 1870)
93. *Nymphalis vau-album watsoni* (Hall 1924)
94. *Nymphalis californica* (Boisduval 1852)
95. *Nymphalis antiopa antiopa* (Linnaeus 1758)
96. *Aglais milberti furcillata* (Say 1825)
97. *Vanessa virginiensis* (Drury 1773)
98. *Vanessa cardui* (Linnaeus 1758)
99. *Vanessa annabella* (Field 1971)
100. *Vanessa atalanta rubria* (Fruhstorfer 1909)

Argynninae

101. *Speyeria cybele* (Fabricius 1775)
    a. *S. c. pugetensis* Chermock & Frechin 1947
    b. *S. c. leto* (Behr 1862)

102. *Speyeria coronis simaetha* dos Passos & Grey 1945
103. *Speyeria zerene* (Boisduval 1852)
    a. *S. z. hippolyta* (Edwards 1879)
    b. *S. z. bremnerii* (Edwards 1872)
    c. *S. z. picta* (McDunnough 1924)
104. *Speyeria callippe semivirida* (McDunnough 1924)
105. *Speyeria egleis* (Behr 1862)
    a. *S. e. oweni* (Edwards 1892)
    b. *S. e. macdunnoughi* (Gunder 1932)
106. *Speyeria atlantis* (Edwards 1862)
    a. *S. a. dodgei* (Gunder 1931)
    b. *S. a. beani* (Barnes & Benjamin 1926)
107. *Speyeria hydaspe* (Boisduval 1869)
    a. *S. h. minor* dos Passos & Grey 1947
    b. *S. h. rhodope* (Edwards 1874)
    c. *S. h. sakuntala* (Skinner 1911)
108. *Speyeria mormonia* (Boisduval 1869)
    a. *S. m. washingtonia* (Barnes & McDunnough 1913)
    b. *S. m. erinna* (Edwards 1883)
109. *Clossiana selene atrocostalis* (Huard 1927)
110. *Clossiana bellona* (Fabricius 1775) 'ssp'
111. *Clossiana epithore chermocki* (E & S Perkins 1966)
112. *Clossiana freija freija* (Thunberg 1791)
113. *Clossiana astarte astarte* (Doubleday & Hewitson 1847)
114. *Clossiana titania rainieri* (Barnes & McDunnough 1913)
115. *Phyciodes tharos* (Drury 1773)
    a. *P. t. pascoensis* Wright 1905
    b. *P. t. arctica* dos Passos 1935
116. *Phyciodes campestris campestris* (Behr 1863)
117. *Phyciodes pallida barnesi* Skinner 1897
118. *Phyciodes mylitta mylitta* (Edwards 1861)
119. *Charidryas palla* (Boisduval 1852)
    a. *C. p. palla* (Boisduval 1852)
    b. *C. p. calydon* (Strecker 1878)
    c. *C. p. sterope* (Edwards 1870)
120. *Charidryas hoffmanni manchada* Bauer 1975
121. *Euphydryas colon* (Edwards 1881)
    a. *E. c. colon* (Edwards 1881)
    b. *E. c. perdiccas* (Edwards 1880)
    c. *E. c. paradoxa* McDunnough 1927
    d. *E. c. wallacensis* Gunder 1928
122. *Euphydryas anicia* (Doubleday 1847)
    a. *E. a. howlandi* Stallings & Turner 1947
    b. *E. a. hopfingeri* Gunder 1934
    c. *E. a. veazieae* Fender & Jewett 1953
123. *Euphydryas editha* (Boisduval 1852)
    a. *E. e. taylori* (Edwards 1888)
    b. *E. e. beani* (Skinner 1897)
    c. *E. e. edithana* Strand 1914
    d. *E. e. colonia* Wright 1905

Limenitidinae

124. *Limenitis archippus lahontani* (Herlan 1971)
125. *Limenitis lorquini burrisonii* (Maynard 1891)
126. *Adelpha bredowii californica* (Butler 1865)

Satyridae

Satyrinae

127. *Coenonympha tullia* Edwards 1871
    a. *C. t. ampelos* Edwards 1871
    b. *C. t. insulana* McDunnough 1928
128. *Cercyonis pegala* (Fabricius 1775)
    a. *C. p. boopis* (Behr 1864)
    b. *C. p. ariane* (Boisduval 1852)
129. *Cercyonis sthenele paulus* (Edwards 1879)
130. *Cercyonis oetus* (Boisduval 1869)
    a. *C. o. oetus* (Boisduval 1869)
    b. *C. o. phocus* (Edwards 1874)
131. *Erebia vidleri* Elwes 1898
132. *Erebia epipsodea hopfingeri* Ehrlich 1954
133. *Oeneis nevadensis nevadensis* (C & R Felder 1866)
134. *Oeneis chryxus* (Doubleday & Hewitson 1849)
    a. *O. c. chryxus* (Doubleday & Hewitson 1849)
    b. *O. c. valerata* Burdick 1958
135. *Oeneis melissa beanii* Elwes 1893

Danaidae

Danainae

136. *Danaus plexippus* (Linnaeus 1758)

NOTE: Since this list was compiled in 1980, the following species has been recorded for the State:

137. *Habrodais grunus herri* Field 1938

The following is a list of species and subspecies which may be found within the borders of Washington State but have not yet been recorded.

Hesperiidae

Thymelicus lineola (Ochsenheimer 1808)
Atalopedes campestris campestris (Boisduval 1852)

Papilionidae

Papilio glaucus canadensis Rothschild & Jordan 1906

Pieridae

Pontia protodice protodice (Boisduval & Leconte 1829)
Colias pelidne skinneri Barnes

Lycaenidae

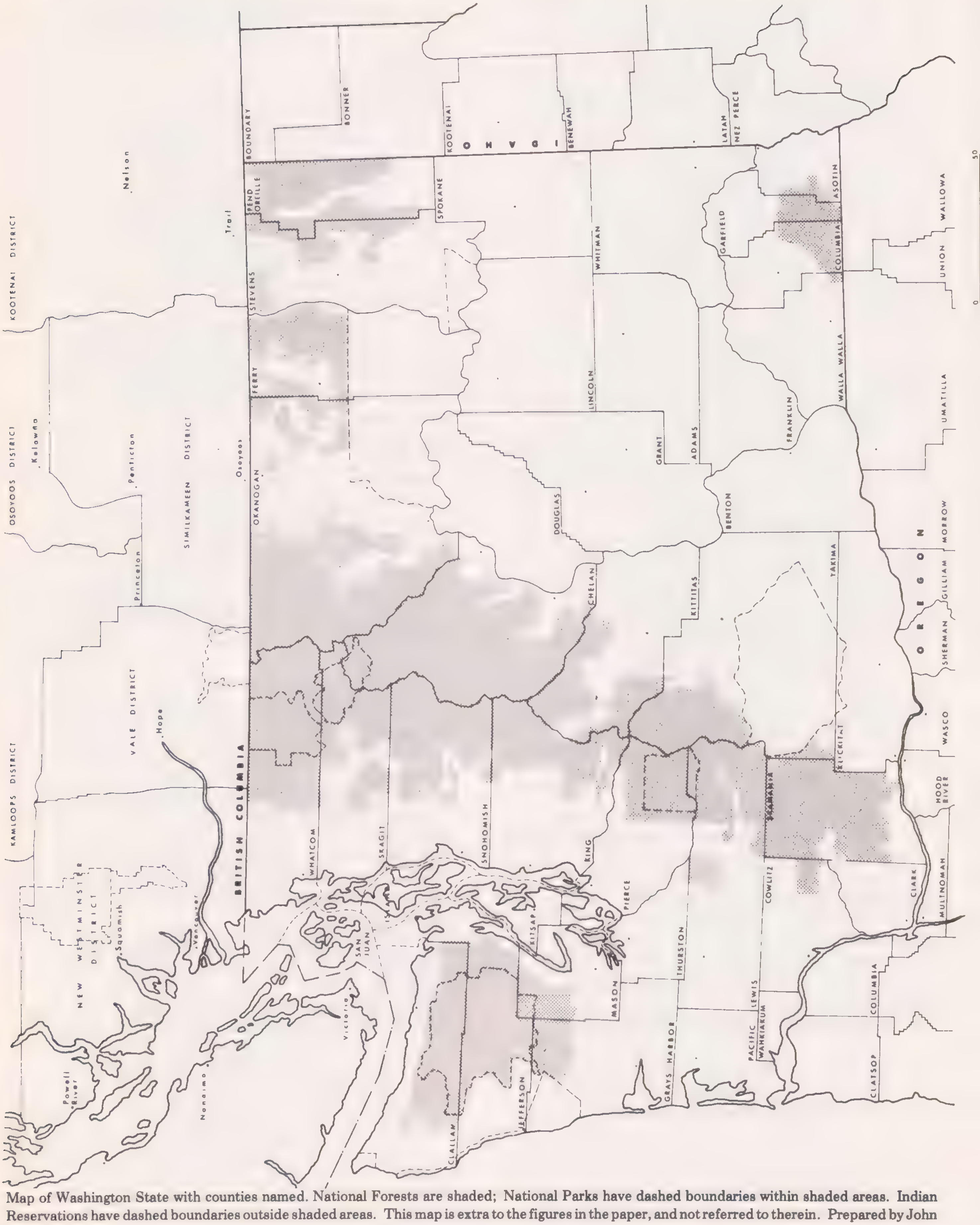
Epidemia dorcas dorcas (Kirby 1837)
Everes comyntas comyntas (Godart 1824)
Icaricia lupini lupini (Boisduval 1869)

Nymphalidae

Speyeria aphrodite columbia (Hy. Edwards 1877)
Charidryas acastus acastus (Edwards 1874)

Satyridae

Coenonympha tullia eunomia Dornfeld 1967
Coenonympha tullia columbiana McDunnough 1928



Map of Washington State with counties named. National Forests are shaded; National Parks have dashed boundaries within shaded areas. Indian Reservations have dashed boundaries outside shaded areas. This map is extra to the figures in the paper, and not referred to therein. Prepared by John Hinchliff.

Notes

Common Names for North American Butterflies

In 1980, the Executive Council of the Lepidopterists' Society and the Board of Directors of the Xerces Society agreed to establish a joint committee on common names. The purpose of the committee is to develop a standardized list of common (English) names for North American butterflies, such as that authorized by the American Ornithologists' Union for birds. The value of such a list will be measured in its ability to diminish confusion, make butterflies more accessible to the public, and lubricate communication about butterflies among non-lepidopterists. The use of scientific names is to be encouraged, but they do create a barrier between some people and the organisms they denote. The common names list, therefore, is intended to serve as an alternative nomenclature for those who prefer the vernacular; certainly not as a replacement for the precise Latin designation.

The joint Common Names Committee has been formed under the chairmanship of R. M. Pyle. Their task involves the collation of all previously published or suggested versions of English names; circulation of a master list to members of the committee for their comments, and search for a concensus on the most appropriate names to put forward in a short list. Distinguished referees will then be asked to review the short list and indicate their preferences. In cases of spirited disagreement, committee members will be asked to vote. The final draft list will then be presented to the Councillors of the Lepidopterists' Society and the Directors of the Xerces Society for their approval. Once this has been obtained, the "official" list will be printed and distributed by one or both of the societies. Of course, anyone will remain free to use whatever name he or she prefers for a butterfly. The list will furnish, however, a standard set of names available for use by anyone referring to butterflies in circumstances requiring an English designation. It is anticipated that the two societies will encourage the adoption of these standardized names wherever they may prove suitable and helpful.

Members of the two societies involved can help in the preparation of the common names list. In the first place, they can submit candidate names: either published names from books, papers or other sources that we may have overlooked in our literature review, or unpublished names from regional lists or local usage. Secondly, I would be pleased to hear from anyone with a strong interest in this subject and who may wish to join the committee's effort or to express views on the philosophy or method of name selection. It was originally hoped to complete the job within two years, but it now appears that the size of the task will necessitate an extra few months. There is still time for any views to be taken into account and any candidate names to be added to the master list.

Members of the joint Common Names Committee are as follows:

Jo Brewer, Cliff Ferris, Clyde Gillette, Sally Hughes, Roy Kendall, John Lane, Joanna McCaffrey, Jackie Miller, Paul Opler, Larry Orsak, James Scott, Art Shapiro, Jon Shepard, Ray Stanford, and Bob Pyle.

Robert Michael Pyle, Swede Park, Loop Road Box 123, Gray's River, Washington 98621 U.S.A.

Atala Abstracts

Resuming its former title, this section continues to furnish abstracts of literature pertaining to invertebrate conservation. As well as recently published papers, ATALA ABSTRACTS pays attention to articles and books of an earlier vintage which have previously been overlooked. The categories established in *ATALA* 7(1) have been foregone in favor of a plain alphabetical listing, since many papers seem to overlap two or more of the categories. The editor welcomes submissions of reprints, photocopies and annotated references for inclusion in ATALA ABSTRACTS. Our intention is to publish an inclusive bibliography on the subject as supplement to a future number of the journal, superseding the first attempt at such a reference list in *ATALA* 2(1). The editor will attempt to fulfill requests for photocopies of shorter papers listed here, at cost ($0.10 per page plus postage). Please write to ascertain availability before sending money.

Gomez-Bustillo, M. R. 1981. Protection of Lepidoptera in Spain. *Beih. Veröff. Naturschutz Landschaftspflege Bad.-Wurtt. 21*: 67-72. The state of Spanish Lepidoptera conservation is reviewed for the three-year period since publication of the Red Book of Iberian Lepdioptera. Three species (*Iolana iolas, Plebicula golgus* and *Parnassius apollo*) are recommended for transfer from the Vulnerable category to the Endangered one, based on a reappraisal of their status. The author considers overcollecting to be a real risk in each case; but the habitats of these species are clearly being degraded as well. A prime *I. iolas* site was ruined for a gypsum pit. An important *P. golgus* locality was impaired by a large development, another by construction of an observatory and a religious memorial. Pine afforestation is damaging *P. apollo*. SHILAP and other organizations are working to halt these declines, but little progress is foreseen. A national park in the Sierra Nevada alpine zone is recommended. An appeal is made to lepidopterists visiting Spain to exercise restraint in collecting rare species.

Goodden, R. and J. A. Thomas. 1981. Butterflies: an introduction to their conservation. Published by and for Butterfly Year 80-81. See elsewhere in this issue for additional description. With ten color photographs and four pages of text, this brochure explains the nature of the "crisis for butterflies" in Britain, introduces Butterfly Year 80-81, and tells what individuals can do to help. Promoting awareness, disturbance of habitat and planting and management are among the subjects briefly discussed. May be obtained from BBCS, P. O. Box 2, Compton House, Sherborne, Dorset, UK.

Heath, J. 1981. Threatened rhopalocera (butterflies) in Europe. Council of Europe Nature and Environment Series, No. 23 (Strasbourg), 157 pp. An exhaustive survey of the butterflies of all the countries of Europe (except Turkey and Cyprus) has resulted in what amounts to a Red Data Book of European species. Each species account covers names, status, foodplant, world distribution, European distribution, population in Europe (and individual countries), Habitat, Reasons for decline, Conservation measures taken and Conservation measures proposed. Fifteen species are ajudged Endangered in Europe, fifty-one are Vulnerable, thirteen Rare and at risk, and seventeen species suspected of belonging to one of the foregoing categories but indeterminate as such at present. Habitat destruction of various kinds is the most substantial cause for this large proportion of the European butterfly fauna being in jeopardy. Acid rain is suggested as possibly influencing the decline of butterflies in a number of countries and a factor bearing much closer examination. This valuable survey points the way for conserving Europe's butterflies, while it offers a stark viewpoint of their present plight.

Kasy, F. 1981. Naturschutzgebiete im östlichen Österreich als Refugien bemerkenswerter Lepidopterenarten. *Beih. Veroff. Naturschutz Landschaftspflege Bad.-Wurtt. 21*: 109-120. Nature reserves in eastern Austria as refuges of remarkable species of Lepidoptera. A general view is given, from the lepidopterological standpoint, of the most important reserves in Eastern Austria (i.e. Niederosterreich and Nordburgenland) together with their most noteworthy species. Most of these species have distribution limits in eastern Austria and are therefore absent from large parts of Central Europe. One of them, the geometrid *Chondrosoma fiduciaria* Anker, has only been identified from a few sites in Russia and the southeastern part of Central Europe. The areas dealt with have generally been established as reserves through purchase or lease, mostly with the aid of the World Wildlife Fund and the Austrian Nature Conservation Society (Oesterreicher Naturschutzbund). (In German, with English summary as above. Contains a number of references by the same author on the subject.)

Key, K. H. L. 1978. *The Conservation Status of Australia's Insect Fauna.* Occas. Paper No. 1, Austral. Nat'l. Parks and Wildlife Serv., Canberra. 24 pp. This provacative and pioneering paper places Australian insects in biological and ecological perspective, then goes on to consider cases. The contents include important characteristics of insects, the ecological role of insects in biotic communities, close dependence of insects on habitats, insect conservation, endangered species of insects, research programmes warranting support, and references. The only species of Australian insects considered endangered by the author are those endemic to Lord Howe Island and certain dragonflies and grasshoppers. Uranium mining threatens certain odonates of permanent streams; others in a rich spring system are at risk from aquifer-draining due to industrial expansion, and some dune lake species are jeopardized by sand mining. Wingless, endemic Australian grasshoppers known as morabines are thretened by sheep grazing and cropping. An important feature of the booklet is the set of recommendations for research vital to insect conservation understanding and management. This paper makes a significant step in the progress of insect conservation in Australia, interesting for its emphasis on non-Lepidoptera.

Manzano, A. 1982. La finca "El Regajal", en Aranjuez, uno de los hábitats de mariposas más importante del mundo. *El Pais* (Madrid) 16 March. Newspaper article explaining the entomological importance of the relict scrubland known as El Regajal, south of Madrid. This site, with its several endemic species and races of insects, has been seriously at risk from industrial, residential and recreational development. Authorities have been impressed by the international concern over the site and are now planning to set aside a significant portion of it as a nature reserve. The interest of IUCN's Lepidoptera Specialist Group is mentioned. El Regajal is is compared to Mount Kaindi, Papua New Guinea, and Gothic, Colorado, as one of the great centers of historical research importance for entomology.

Tyler, J. 1979. *The Ecology and Conservation of the Glow Worm,* Lampyris noctulica. M.Sc. Dissertation in Conservation, University College, London. 65 pp. The glow worm beetle is believed to have declined substantially in Britain over the past decade or two. This study aimed to identify the factors responsible, determine habitat requirements, and assess the significance of the British decline with respect to the status of the species as a whole. The author determined that the species is not likely to be globally endangered, although efforts to conserve the glow worm in Great Britain are in order. Whether it is declining elsewhere, as in Britain, should be investigated. The sessible condition of the wingless females probably exacerbates the impact of habitat disruption upon populations. Captive breeding of the species is not practical. The beetle is found in a variety of grasslands, particularly on chalk, and its appearance is significantly correlated with the distribution of two species of terrestrial snails. Apart from habitat alteration, the glow worm is disappearing from apparently suitable sites for no obvious reasons. Environmental factors as yet not understood may be involved, and these could frustrate efforts to conserve the glow worm through habitat protection measures.

EDITORIAL STAFF OF *ATALA*

SUGGESTIONS FOR CONTRIBUTORS

Formal scientific articles and notes dealing with any aspect of the ecology and conservation of invertebrates and their habitats are solicited. Articles will generally be longer papers, notes not exceeding 1000 words. Reviews of books dealing with terrestrial arthropod conservation or endangered habitats are also invited. Appropriate philosophical papers will be welcomed for use in the "Commentary" section.

All manuscripts should be typewritten on white, 8½ x 11 inch, good quality bond paper, on one side only, double- or triple-spaced throughout, with margins of at least one inch on all sides. The original typescript and at least one (preferably two) xeroxed or carbon copies should be submitted; authors should also retain a copy of manuscripts and figures for later consultation with the editors.

Please include illustrations if appropriate. Figures should be consecutively numbered in Arabic numerals. Hand-drawn figures should be rendered in black ink on good quality white paper. They may be larger than final reproduced size. Black and white glossy photographs may also be submitted. These and artwork will be returned after publication if accompanied by return postage. Figure captions should be typed, double-spaced, on a separate sheet, and the number of the figure lightly pencilled on the back of each drawing or photograph. A sketch map should be included as a figure with all articles or notes dealing in a major way with a specific region or arthropod habitat.

Cover art changes with each issue, and contributions will be gratefully received. Cover illustrations should generally show insects or other arthropods in natural settings, and prospective cover artists should consult with the Editor before submitting material.

Tables should be numbered consecutively in Arabic numerals and submitted in camera-ready condition on separate sheets. Please include full scientific name, *with authors*, for both plants and animals mentioned in any manuscript submitted for publication in *Atala*. The metric measurement system should normally be used, with English system equivalents in parentheses if desired. Full references to literature cited should appear in a separate section at the end of articles or commentary papers, but parenthetically incorporated within the text of notes. Please include an *informative abstract* of approximately 150 to 250 words with all articles. Avoid footnotes to text statements if possible; such information can usually be included within the text. Words to be set in *italics* (including scientific names) should be underlined. Reprints of articles are available at cost. An author will receive a reprint order form after acceptance of a manuscript. The style of *Atala* generally follows that recommended in the *CBE Style Manual* (1972). Abbreviations of journal titles follow *Bibliographic Guide for Editors and Authors* (1974).

COVER

The bramble green hairstreak (*Callophrys dumetorum*) reflects the verdant quality of its domecile, the maritime Pacific Northwest. It is shown at rest on a leaf of salal (*Gaultheria shallon*), a dominant shrub of the Northwest woods. The butterfly and the plant both represent Washington State, whose butterflies and nature reserves are the theme of this issue. The bramble green hairstreak actually occurs southward to Baja California, where it flies in arid habitats. Yet in Washington it is one of the few butterflies well adapted to the moist coniferous forests, where it basks in clearings and seeks mates, nectar or its host *Lotus* during sunny intervals. Far from endangered yet adapted to specific habitats, this and other Washington butterflies reveal statewide conservation lacunae when their patterns of distribution are compared against those of nature reserves.

This is the latest *Atala* contribution of Sarah Anne Hughes, botanical printmaker and illustrator. Ms. Hughes has recently exhibited her etchings of native Northwest plants at the Royal Horticultural Society in London, and she is presently illustrating the international Invertebrate Red Data Book in Cambridge.

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ATALA

Volume 8, Number 2 1980(82)

THE XERCES SOCIETY

An international, non-profit organization dedicated to the conservation of terrestrial arthropods and their habitats. Named for the extinct Xerces Blue Butterfly, *Glaucopsyche xerces* (Boisduval). Founded on 9 December 1971.

MEMBERSHIP INFORMATION

Membership in the Xerces Society is open to all interested persons and institutions upon submission of appropriate dues. Adult memberships and institutional subscriptions are US $8.00 and student memberships are US $4.00 for the 1981 calendar year. All members and institutional subscribers normally receive the journal *Atala* twice yearly; the less formal newsletter *Wings* three times yearly; *Self-Help Sheets* (informal, how-to articles) and *Educational Leaflets* (short, informal, informational) irregularly, as they are issued; and Society meeting announcements, membership lists, and other communications. Xerces Society publication and administration costs are covered by dues and contributions, all of which are tax-deductible. A person or institution interested in receiving Xerces Society publications should submit name, address, and appropriate dues to the Treasurer, *Stephen Chang, 304 West 236th Street, Bronx, New York 10463, USA*.

Changes of address, requests for back issues of all publications, and general correspondence about the Society should be sent to the Secretary, *Terry Clifford, Department of Zoology & Physiology, University of Wyoming, Laramie, Wyoming 82071, USA*. Correspondence about terrestrial arthropod conservation issues and Xerces Society policies should be addressed to the President, *Karolis Bagdonas, I. B. P. Lab, Room 110, Biochemistry Bldg., University of Wyoming, Laramie, Wyoming 82071, USA*. Suggestions for *Self-Help Sheets* and *Educational Leaflets* and miscellaneous publications can be addressed to the President or to the Miscellaneous Publications Editor, *Larry J. Orsak, Department of Entomology, University of California, Berkeley, California 94720, USA*. *Atala* contributions should be mailed to the Editor, *Robert Michael Pyle, Swede Park, Loop Road, Box 123, Gray's River, Washington 98621, USA*. Less formal items for inclusion in the Xerces Society newsletter *Wings* should be addressed to the Editor, *Lawrence F. Gall, 360B OML, Department of Biology, Yale University, New Haven, Connecticut 06520, USA*. Questions, comments or contributions to the annual Butterfly Count should be sent to the Butterfly Count Coordinator, *Ira Heller, 38 Laconia Street, Lexington, Massachusetts 02173, USA*.

Published at Los Angeles, California, USA, in May 1982 by the Xerces Society in cooperation with The Lepidoptera Research Foundation.

ATALA

JOURNAL OF THE XERCES SOCIETY

Volume 8 **1980(82)** **Number 2**

Articles

Population Status of the Tiger Beetles of the Genus *Cicindela* (Coleoptera: Cicindelidae) Inhabiting the Marine Shoreline of Southern California

Christopher D. Nagano

Research Associate, Entomology Section, Natural History Museum of Los Angeles County,
900 Exposition Blvd., Los Angeles, California 90007, USA

Abstract

Information about the population status of the tiger beetles (*Cicindela*) inhabiting the seashore of southern California gathered during field work in 1979 is given. The area of study extends from the San Luis Obispo/Santa Barbara County line south along the marine shoreline to the Mexican border. The Channel Islands are included. Seven species are recorded as definitely living along the sea coast; one is a doubtful inhabitant and two species are eliminated as possible seashore tiger beetles. Rare or extinct over much of their former ranges are *Cicindela hirticollis gravida, C. gabbi, C. latesignata latesignata* and *C. senilis frosti. C. latesignata obliviosa* is very localized or possibly extinct. *C. haemorrhagica pacifica* and *C. trifasciata sigmoidea* may become threatened without proper protection. Two tiger beetles, *C. oregona oregona* and *C. haemorrhagica haemorrhagica* are neither endangered or threatened. Ecological notes, habitat and behavioral data are included. Present and future threats to marine littoral tiger beetle populations are discussed, and recommendations for their conservation presented.

Introduction

Four genera of the tiger beetle family Cicindelidae occur in North America. Of these, only the genus *Cicindela* is commonly found along the southern California coastline.* The vast majority of literature on the tiger beetles of this region have been primarily restricted to taxonomy, with little work on their ecology.

Dunn (1891) was the first to write about California tiger beetles, briefly discussing the habits of the adults and larvae. Dunn also included notes on the range and flight periods of the *Cicindela* that were then known to inhabit California.

The Cicindelidae of San Diego County were examined by Blaisdell (1892), who discussed the nine species of tiger beetles that he felt inhabit the sea coast. He incorrectly stated that a desert species, *C. tenuicincta* Schaupp, could be found with *C. latesignata* Le Conte on the coastal beaches and alkaline flats. Blaisdell (1925) later admitted that he had misidentified specimens of the latter.

Schaupp (1884) reviewed the family in North America, including those found along the shoreline of southern California. Wickham (1900) described the habits and flight periods of many tiger beetles inhabiting the United States. He included information on species of the southwestern sea coast.

Leng (1902) revised the North American species of Cicindelidae; he included keys, taxonomic descriptions, range and brief habitat notes.

Moore (1937) listed eleven species of tiger beetles from the San Diego area, eight of which were stated to inhabit the marine shoreline.

The larvae of tiger beetles were described by Hamilton (1925) and some marine littoral *Cicindela* were included: *C. latesignata* Le Conte, *C. oregona* Le Conte, *C. hirticollis* Say and *C. trifasciata* Fabricius. However, Hamilton indicated that the identifications of field collected specimens were not positive since they were based on the process of elimination from known reared species rather than by rearing them to the adult stage.

A taxonomic description with notes on the flight periods and distribution of *Cicindela senilis* Horn was published by Cazier (1936). Cazier (1948, 1954) published works on the Cicindelidae of Mexico, including some species found along the coastline of California.

The *Cicindela maritima* complex in North America was revised by Freitag (1965). Included in this group is *C. oregona*

*Coastal tiger beetles are marine littoral species, which inhabit sea beaches and coastal tidal flats.

which occurs along the shoreline of southern California.

Freitag (1971) and Lawton (1972) made collecting trips through the southwestern United States and published brief collecting notes on the California marine littoral *Cicindela* encountered.

I investigated the tiger beetles of the genus *Cicindela* that inhabit the California sea coast from the San Luis Obispo/Santa Barbara County line south along the shoreline to the Mexican border, to document the present population status of the marine littoral *Cicindela*. These insects have been greatly reduced in range due to the activities of man, such as the use of insecticides on salt marsh mosquitoes, the dredging and filling of estuarine habitats and the increased recreational use of beaches.

Materials and Methods

During the spring, summer and fall of 1979, I visited as many coastal tiger beetle habitats as possible to obtain specimens and to record the general condition of suitable *Cicindela* habitats. Four major field trips with many shorter excursions covering approximately 700 miles were made. Three of the eight California Channel Islands were visited: San Nicolas, Santa Catalina and Santa Cruz.

Localities that were known, from literature and collection data, to be inhabited by tiger beetles were sampled. Also, I visited as much of the coastline as possible to discover new tiger beetle locales. To find potential habitats I used topographic maps and searched for suitable sites while driving along the seashore. When populations were found, I collected *Cicindela* for systematic study and to serve as voucher specimens for ecological observations. I also recorded effects of human influence, such as construction, pollution or other detrimental factors. The habitats where tiger beetles are currently living are listed under *Present Localities* and localities from which they have been eradicated are under the heading of *Former Localities* for each species.

I used an aerial net and an ultraviolet light to collect adult tiger beetles. Certain species of *Cicindela* are active at night and they can be attracted to ultraviolet light. I collected pupae, larvae and eggs by digging them out of the soil. The adults were killed in cyanide jars, degreased with ether and pinned. The pupae and eggs were boiled in water for two minutes, while the larvae were killed in KAAD before they were all placed in 95% ethyl alcohol. All the specimens collected for this study have been deposited in the Natural History Museum of Los Angeles County.

In addition to specimens collected personally along the southern California sea coast, public and private collection records were examined. These collections are listed in the Acknowledgments.

General Ecology

Tiger beetles are highly active terrestrial predators that are well equipped morphologically for stalking and hunting small arthropods. *Cicindela* will eat any arthropod they can overpower, such as isopods, moths, ants and flies, including kelp flies.

In addition to being able to run very quickly, tiger beetles are agile fliers. They are wary and difficult to approach, taking flight rapidly and alighting some distance away from the pursuer. They are most active during periods of warm sunshine in the spring, summer and fall.

Adult *Cicindela* are found on mud or sand near permanent bodies of water. Each predaceous grub-like larva inhabits a vertical burrow in the soil around the same area as the adults. It positions itself at the entrance to the burrow ready to capture any passing arthropod.

The larva has spines on the fifth abdominal segment which it drives into the side of the burrow if the prey threatens to drag it out. It uses its hook-like mandibles to kill the victim, which is taken to the bottom of the hole and eaten.

The depth of the burrow varies according to species, age of the larva, geography and topography. Burrows of *Cicindela formosa* Say, a tiger beetle inhabiting the eastern United States, range from 30 cm deep in Texas to 95 cm in Canada. The reason for the much greater depth is probably for thermoregulation. The burrows of *Cicindela trifasciata* Fabricius, a species found along the southern California sea coast vary in depth from 1 cm for the first instar larva to 15 cm for the final, third instar, because of the larger size of the older larva.

Ecological Importance

Because their prey includes many insect species injurious to man and crops, tiger beetles are regarded as beneficial. On the coastline of southern California I observed adult *Cicindela* often feeding on kelp flies, especially the families Coelopidae and Anthomyidae. Kelp flies are considered to be both beneficial and annoying insects. The seaweed wrack that is deposited on the seashore is eaten by larvae flies, but the adults are highly disturbing to humans using the beach. The simple presence of flies on people and food is annoying. Kelp flies can be quite numerous; 10,000,000 adult *Fucellia* per kilometer were estimated to be inhabiting the sea beach near Scripps Institution of Oceanography on a warm summer day (Cheng, 1978). This is not an uncommon situation where there are many piles of wrack (C. L. Hogue, pers. comm.). It is highly probable that tiger beetles, along with rove beetles (Staphylinidae) and to a lesser degree ground beetles (Carabidae), are the major predators of kelp flies.

Tiger beetles are themselves the prey of various carnivores (Maser, 1973). They are eaten by robber flies of the family Asilidae (Lavigne, 1972) and dragonflies (Anisoptera). Numerous vertebrates feed on *Cicindela* including hawks, killdeer, toads, lizards, shrews and racoons (Larochelle, 1975).

I have observed marine littoral tiger beetles to be the victims of two parasites. One is a bee fly (Bombyliidae) of the genus *Anthrax* that lays its eggs on *Cicindela* larvae. The fly maggots feed on the larva and kill it. This fly genus is widespread in North America.

The second were mites found on a single adult *Cicindela haemorrhagica* Le Conte in San Diego County. They are erythraeid mites of the genus *Leptus*, which have a life cylce consisting of a parasitic hexapod larva followed by a free-living octopod nymph and adult (W. Calvin Welbourn, pers. comm.). I have not found mites on other tiger beetles at this or any other locality during several years of collecting. Willis (1967) found mites on two other species of tiger beetles, *Cicindela sexguttata* Fabricius and *Cicindela circumpictata* Laferte-Senectre.

Habitat Destruction

Tiger beetles are generally severely threatened by man's activities (Wilson, 1970) and many marine littoral populations in southern California have been totally eradicated. The

dangers are oil spills, urban expansion, insecticide use and the increased recreational use of the beach.

Oil spills from offshore drilling wells or tanker wrecks are a conceivable danger to marine littoral tiger beetles (Wilson, 1970). Evans (1970) postulated that oil spills could have detrimental effects on members of the beetle family Carabidae that inhabit the seashore of Santa Barbara County. The larvae of tiger beetles are especially vulnerable because the petroleum can easily reach the larval burrows during high tides. Oil can cause death by smothering the larvae (Dunn, 1978b), reducing their resistance to low temperatures by coating the epicuticle or by acting as a direct toxin.

The improper use of insecticides is a definite danger to tiger beetles. Frick (1957) documented an incident in which an entire population of *Cicindela haemorrhagica* and *C. pusilla* Say (= *C. cinctipennis* Le Conte) in the state of Washington was eradicated. The tiger beetles were erroneously thought to have been feeding on a colony of beneficial alkaline bees, which later investigation has shown *Cicindela* rarely eat. Dunn (1978a) felt that insecticide spraying for the control of salt marsh mosquitoes may have been responsible for the disappearance of *C. marginata* Fabricius in Rye, New Hampshire. Dunn (1978b) also states that pesticide control measures for the Spruce Budeworm in Maine and eastern Canada could seriously affect woodland tiger beetles, such as *C. sexguttata* and *C. longilabris* Say.

Off-road vehicles (ORV) are a tremendous threat to tiger beetles. The adults are relatively immune to human intrusion of their habitat, but larval burrows are easily collapsed and the larvae crushed. Wilson (1970) reported that *Cicindela* populations in eastern regions of the United States have been decimated by ORV use. For the same reason intensive human and animal foot traffic can also cause reduction of tiger beetles.

A serious problem for tiger beetles inhabiting sandy beaches is the removal of kelp wrack. Local governments often remove the piles of kelp for aesthetic reasons and the elimination results in the disappearance of arthropods that are fed upon by the *Cicindela*. I found this to be a serious problem in San Diego County.

Urban expansion along the coastline, especially dredging and filling of estuarine habitats, poses the greatest danger to marine littoral *Cicindela*. Entire populations of several species of tiger beetles have been totally eliminated by the construction of marinas and harbors along the southern California seashore.

Seashore Zonation

Marine littoral tiger beetles exhibit specific zonation in the area of the shoreline they inhabit. There are two zones determined by the amount of moisture and the composition of the soil. The Lower Zone is next to the waterline and consists of mud or sand that is very wet. It extends to the drift line where the soil can be moist. The Upper Zone extends inland from the drift line for five or six meters. Here the soil is usually dry and is wetted only by the highest tides. The drift line is the delineation between the two zones. It is important to note that the two zones are not entirely restrictive because tiger beetles will often wander from one zone to the other.

Cicindela in the Lower Zone are often observed feeding on kelp flies and other arthropods that inhabit piles of seaweed wrack. Those found in the Upper Zone feed primarily on ants and other completely terrestrial insects.

Subspecies

Subspecies names are used in this study for groups of populations that are distinct from other populations of the same species. Populations are considered distinct if (following Kavanaugh, 1979): 1) the differences between members of each population are constant, but less than the differences between two closely related sympatric species in one or more characters of color, size or structure and 2) the geographical patterns of variation in distinguishing characters is discontinuous.

The Southern California Marine Littoral Tiger Beetles

Seven species of the genus *Cicindela* are definitely known to inhabit the southern California sea coast. Five are represented by one subspecies each, one by two subspecies and the seventh is monotypic. One additional species is a doubtful inhabitant and two others are eliminated as possible marine littoral tiger beetles.

Authenticated:
- *C. oregona oregona* Le Conte, 1857
- *C. hirticollis gravida* Le Conte, 1851
- *C. latesignata latesignata* Le Conte, 1851
- *C. Latesignata obliviosa* Casey, 1913
- *C. senilis frosti* Varas-Arangua, 1927
- *C. trifasciata sigmoidea* Le Conte, 1851
- *C. haemorrhagica haemorrhagica* Le Conte, 1851
- *C. haemorrhagica pacifica* Schaupp, 1884
- *C. gabbi* Horn, 1866

Doubtful:
- *C. tranquebarica viridissima* Fall, 1910

Eliminated as possible inhabitants:
- *C. willistoni pseudosenilis* Horn, 1900
- *C. nevadica nevadica* Le Conte, 1857

Cicindela oregona Le Conte

This is a western North American species, ranging from Alaska south to Mexico and from the Pacific Ocean east to Colorado and New Mexico.

The subspecies inhabiting the southern California coastline is the nominate one. It can be found along the sea beaches and on tidal flats and prefers dark moist sand in the Lower Zone. The life history of this subspecies has been described by Misumi (1967).

Freitag (1965) extensively investigated this species and found that it interbreeds with *C. duodecimguttata* Le Conte in the northern Rocky Mountains. Rumpp (1979b) believes that this represents subspecies rather than species hybridization. If this is correct, then *C. oregona* would become a subspecies of *C. duodecimguttata* because the latter name takes precedence.

Present Localities:

Santa Barbara County: Goleta; Campus of the University of California at Santa Barbara; Coal Oil Point; Santa Cruz Island

Ventura County: McGrath State Beach, Point Mugu Naval Air Station; San Nicolás Island

Los Angeles County: Ballona Creek at Marina del Rey

San Diego County: San Onofre State Park; Santa Margarita River mouth; Carlsbad; Del Mar; Border Field State Park

Population Status:

Cicindela oregona oregona is found throughout western North America and it is in no danger from the activities of man. It is

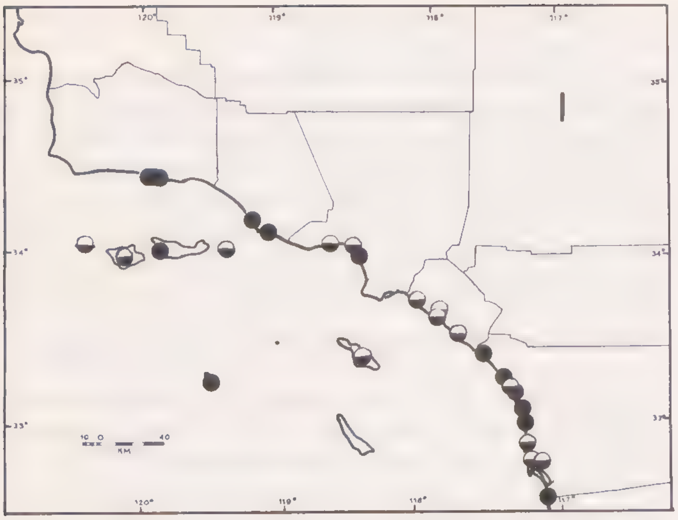

Figure 1. *Cicindela oregona oregona* Le Conte (coastal localities only): ● present localities; ◒ recorded localities.

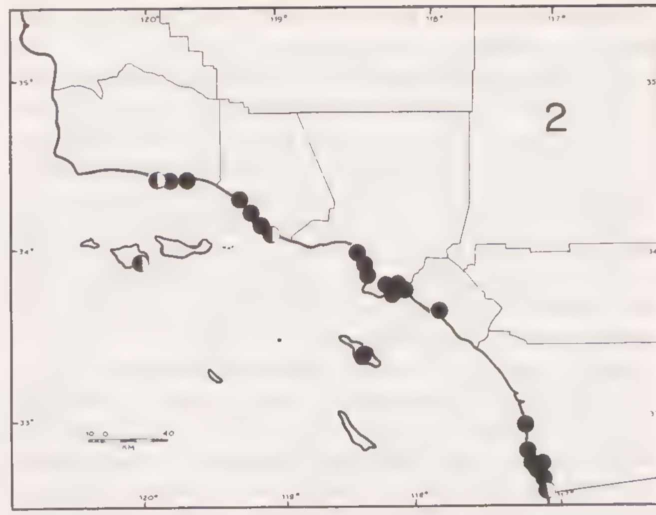

Figure 2. *Cicindela hirticollis gravida* Le Conte: ◐ present localities; ● recorded localities.

one of the most common tiger beetles along the sea coast.

Former Localities:

Santa Barbara County: San Miguel Island; Santa Rosa Island

Los Angeles County: Malibu; Santa Monica; Santa Catalina Island

Orange County: Newport; Balboa; Huntington Beach; Doheny State Beach

San Diego County: San Diego; La Jolla; Ocean Beach; Oceanside

Cicindela hirticollis Say

This species has an extensive range in Canada, the United States and northern Mexico. There is a great deal of variation in this tiger beetle and a number of subspecies have been described.

Cicindela hirticollis gravida inhabits the sea coast of southern California. Its range extends from the San Francisco Bay area south into Mexico.

This tiger beetle inhabits clean, dry, light colored sand in the Upper Zone. I have always encountered subspecies *gravida* in areas close to or next to non-brackish water, such as stream mouths (Coal Oil Point) and barrier beaches (Border Field State Park and Point Mugu Naval Air Station). This species is very sensitive to contact with humans.

Present Localities:

Santa Barbara County: Coal Oil Point, Southeast Anchorage Beach on Santa Rosa Island

Ventura County: Point Mugu Naval Air Station

San Diego County: Border Field State Park

Population Status:

Cicindela hirticollis gravida was found at only one mainland locality in Santa Barbara County, although many other suitable habitats were investigated. Much of the Santa Barbara County coastline is unaccessible private property and it is highly possible that small numbers still survive in Vandenberg Air Force Base, Carpinteria and west of Santa Barbara.

It is possible that populations of low density exist on the Silver Strand in San Diego County (the barrier beach of San Diego Bay). However this area is used by the U. S. Navy for amphibious landings, an activity which could be damaging to any *C. h. gravida* popuations.

The three mainland populations of *C. h. gravida* on the southern California seashore are of low densities and their habitats must be preserved if they are to survive. The size and status of the Santa Rosa Island population is unknown.

Former Localities:

Santa Barbara County: Carpenteria; Goleta

Ventura County: Ventura; McGrath State Beach; (Port Hueneme

Los Angeles County: Santa Monica; Playa del Rey; Redondo Beach; San Pedro; Terminal Island; Long Beach; Naples; Santa Catalina Island

Orange County: Newport

San Diego County: Del Mar; Mission Beach; Ocean Beach; San Diego; Silver Strand; Coronado

Cicindela senilis Horn

This species inhabits the state of Oregon, Nevada and California. Along the southern California coastline the subspecies *C. s. frosti* Varas-Arangua is found. This name represents populations which are slightly green-colored when compared to the brown-colored nominate subspecies which inhabits the San Francisco Bay area and the San Joaquin Valley. This characteristic is only noticeable when large samples are examined. The subspecific name *frosti* was synonymized by Cazier (1936) and it is erroneously thought by many tiger beetle taxonomists that the name represents teneral specimens (sexually immature adults).

The subspecies *C. s. frosti* has an approximate range along the marine shoreline from the central California coast south to the salt marshes of San Diego County. The range of *C. s. frosti* is vague because there are so few records of it.

I have collected *C. s. frosti* on dark-colored mud in the Lower Zone (Point Mugu Naval Air Station) and on a dried salt pan in the Upper Zone (Del Mar). This subspecies is uncommonly collected because populations naturally exist at very low levels; the flight period is bimodal in early spring and late fall, times when few entomologists visit the sea coast, and the beetle is restricted to specific, hard-to-locate areas within the marine salt marsh.

Present Localities:

Ventura County: Point Mugu Naval Air Station Lagoon

Population Status:

I found this tiger beetle at the San Dieguito River mouth (Del Mar) in 1972. I have not found it there since, despite returning to the same spot for seven years. The only known population exists at the Point Mugu Naval Air Station and only a single specimen was found.

Former Localities:

Los Angeles County: Manhattan Beach; Long Beach; San Clemente Island

Orange County: Seal Beach; Huntington Beach; Newport Beach

San Diego County: 2 miles north of Solana Beach; San Dieguito River mouth (Del Mar); San Diego

Cicindela latesignata Le Conte

This is an exclusively marine littoral tiger beetle that inhabits southern California and northwestern Mexico. *C. latesignata* has two subspecies along the southern California coastline. In the United States the nominate form has a disjunct distribution. It is found from the Mexican border to La Jolla in San Diego County and from the Orange County line north to San Pedro. The second subspecies, *C. l. obliviosa*, inhabits the seashore from La Jolla north to the Orange County line.

Cicindela latesignata obliviosa is often considered a synonym for the nominate subspecies. It is believed that *C. l. obliviosa* represents specimens with confluent markings that occur within populations with broad markings.

I find that *C. l. obliviosa* occupies a distinct range in northern San Diego County, as does Rumpp (1979a). The following key is adapted from his unpublished paper:

1. Elytral maculation broad, but readily traceable; lunules interrupted from middle band along edge of elytra and rarely connected with each other. San Pedro (Los Angeles County) to Orange County line and Mission Beach (San Diego County) south to Mexican border. . . . . *latesignata*
2. Elytral maculation broad to confluent, but always continuous at outer edge of elytra. Mid San Diego County. . . *obliviosa*

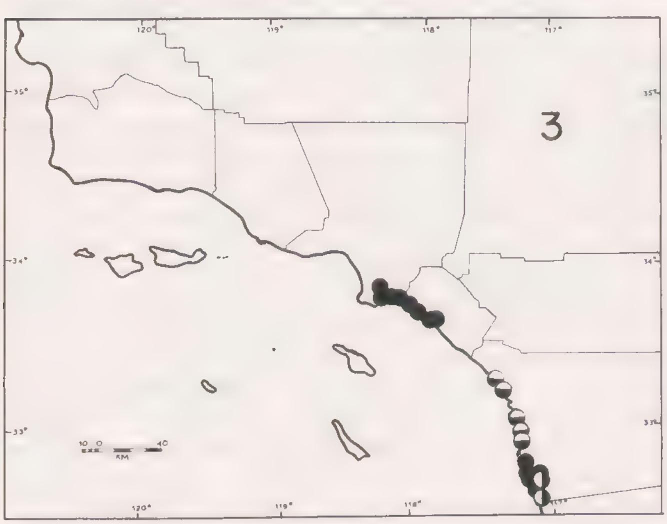

Figure 3. *Cicindela latesignata* Le Conte: nominate subspecies ◑ present localities, ● recorded localities; subspecies *obliviosa* Casey ◒ recorded localities (see text).

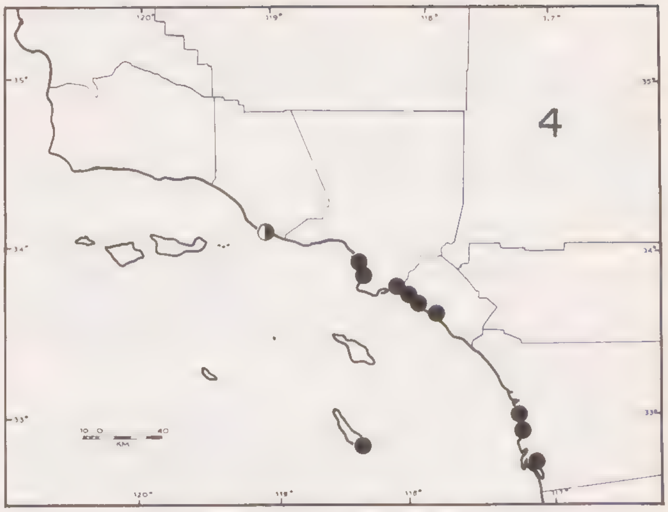

Figure 4. *Cicindela senilis frosti* Varas Arangua: ◑ present localities; ● recorded localities.

Rumpp (1979a) stated that *obliviosa* does not extend as far north as the Orange County line and probably ends at the mouth of the Santa Margarita River mouth in Camp Pendleton. I feel that this subspecies could still inhabit the three stream mouths north of that location. I have been unable to check these localities due to restrictions from the military operations in the area.

Cazier states (pers. comm.) that this species is found in southern California from Naples in Santa Barbara County south to the Mexican border. I have examined several suitable sites in western Los Angeles, Ventura and Santa Barbara Counties and have failed to locate it.

Naples was the name of a town near Long Beach in the early 20th Century (now part of the city of Long Beach) and a train stop in Santa Barbara County. There are several specimens in the Natural History Museum of Los Angeles County bearing the data: "L. L. Muchmore Naples 21-VII-19." I am convinced that they are not from the Naples in Santa Barbara County, because, according to Muchmore's field notes in the Los Angeles Museum, he was collecting tiger beetles in Long Beach and the neighboring Naples on the same day. Muchmore's notes also indicate that he never travelled to Santa Barbara to collect insects. I have also not found any preserved specimens from localities farther north than San Pedro.

I have found this species on mudflats in the Lower Zone (Chula Vista and Border Field State Park); these populations were very small. *Cicindela latesignata* is most common on sandy areas in the Upper and Lower Zones.

Present Localities:

Cicindela latesignata latesignata

San Diego County: Chula Vista; Border Field State Park

Cicindela latesignata obliviosa

No known localities at the present time.

Population Status:

The nominate subspecies has a small population at the Sweetwater River mouth at Chula Vista. A few individuals were observed on the mudflats there in 1979. It was not found at Newport Backbay in Orange County, although conditions seem right for it and it was once quite common there. The largest population is found on the barrier beach of Border Field State Park in San Diego County.

I did not find subspecies *C. l. obliviosa* despite searching for it in 1974 and 1979. It may still exist within Camp Pendleton. I feel that any remaining populations are at extremely low levels and it is even possible that *C. l. obliviosa* is extinct.

Former Localities:
Cicindela latesignata latesignata
Los Angeles County: San Pedro; Los Angeles; Long Beach; Naples
Orange County: Newport Beach; north of Huntington Beach; Huntington Beach; Bolsa Chica Bay; Seal Beach; Balboa
San Diego County: Coronado; Imperial Beach; Ocean Beach; San Diego Bay; National City; Mission Beach; North Island; San Diego; Mission Bay
Cicindela latesignata obliviosa
San Diego County: Torrey Pines; Oceanside; Del Mar; La Jolla; Stuart; San Marcos Creek; 2 miles south of Del Mar; 1 mile south of Del Mar; Sorrento Beach (the last three apply to the same locality).

Cicindela trifasciata Fabricius

This species has an extensive range in South and Central America, the Caribbean and the southern coastal regions of the United States. The subspecies found in California is *Cicindela trifasciata sigmoidea* Le Conte. It ranges from Morro Bay in San Luis Obispo County south along the sea coast to the Mexican border.

This is a mudflat tiger beetle that inhabits the Lower Zone on dark colored mud. Along the banks of Ballona Creek at Marina del Rey I observed it feeding on marine isopods (*Ligia occidentalis* Dana) on rocks and boulders in the intertidal region.

C. trifasciata sigmoidea is often attracted to lights at night.

Present Localities:
Ventura County: Point Mugu Naval Air Station Lagoon
Los Angeles County: Venice Canal at Pacific Avenue; Ballona Creek at Marina del Rey; Catalina Harbor, Santa Catalina Island
Orange County: Newport Backbay
San Diego County: Chula Vista; Mission Bay; Border Field State Park

Population Status:
Three of the known populations are within state parks and military reservations.

Ballona Creek at Marina del Rey is a refugium for three tiger beetle species that once inhabited the former estuary. The estuary was dredged out in the early 1960's to make a boating harbor. The locality could easily be eliminated by careless dumping of toxic chemicals from the many industries upstream from the *Cicindela*.

The extremely small population at Venice Canal is also a remnant from the same former estuary. This area has been highly developed with condominiums in the last few years and I doubt that either the Ballona Creek or the Venice Canal populations will survive in the near future.

The Cataline Harbor habitat is in little danger because the Catalina Island Conservancy has restricted development to the town of Avalon and a few coastal localities.

This tiger beetle was collected by John Shetterly at Mission Bay in 1975. The area is undergoing development as a recreational park and the continued existence of this population is also in doubt.

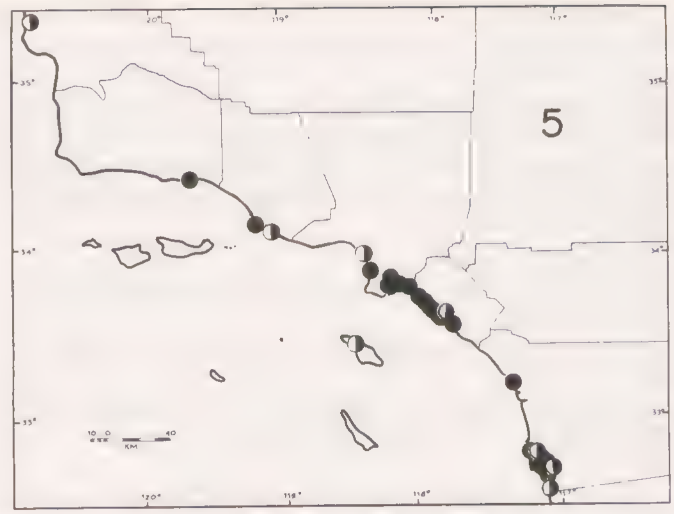

Figure 5. *Cicindela trifasciata sigmoidea* Le Conte: ◒ present localities; ● recorded localities.

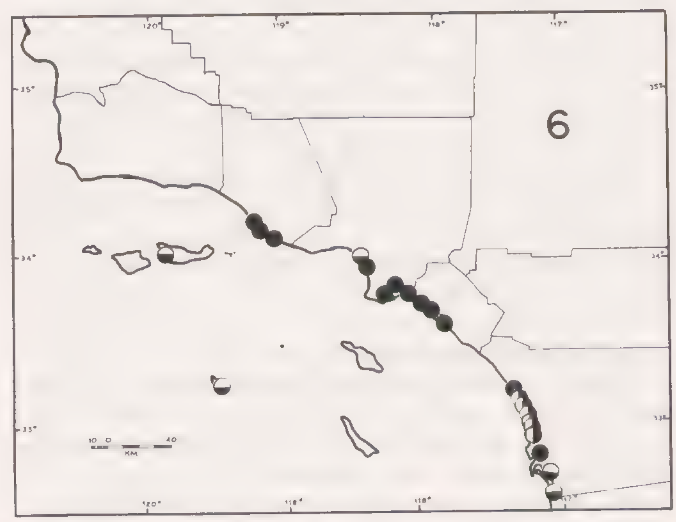

Figure 6. *Cicindela haemorrhagica* Le Conte: nominate subspecies (coastal localities only) ● present localities, ◒ recorded localities; subspecies *pacifica* Schaupp ◑ present localities.

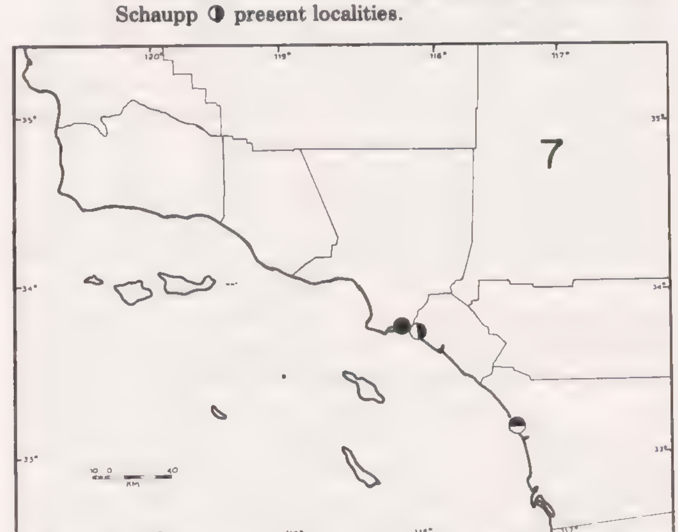

Figure 7. *Cicindela tranquebarica virridissima* Fall: ◒ recorded coastal locality; *C. willistoni pseudosenilis* Horn: ◑ recorded coastal locality; *C. nevadica nevadica* Le Conte: ● recorded coastal locality.

Former Localities:

Santa Barbara County: Santa Barbara

Ventura County: (Port) Hueneme

Los Angeles County: Redondo (Beach); San Pedro; Naples; Long Beach; Los Angeles

Orange County: Anaheim Landing; Balboa; Seal Beach; Sunset Beach; Santa Ana River; Laguna Shores; Costa Mesa; Bolsa Chica; Laguna (Beach); Corona del Mar

San Diego County: Mission Beach; National City; North Island; San Diego; Coronado; Oceanside; leeward side of Silver Strand

Cicindela haemorrhagica Le Conte

Cicindela haemorrhagica ranges from northern Mexico to the state of Washington and from the Pacific Ocean east as far as New Mexico and Wyoming.

There are two subspecies found along the sea coast of southern California. The nominate subspecies ranges from Port Hueeme in Ventura County south to Carlsbad in San Diego County and from La Jolla to the Mexican border; it also inhabits San Nicolas and Santa Cruz Island. Populations found from La Jolla to Carlsbad in San Diego County have a distinct metallic blue coloration instead of the usual black; I consider these populations to represent subspecies *C. haemorrhagica pacifica* Schaupp.

The subspecies *pacifica* was described by Schaupp in 1884. He stated that it was identical with the nominate form "in size, shape and sculpture (and) differs only by the color of the elytra which are olivaceous, opaque greenish or bluish, head, thorax, marin suture and apex of elytra more shining, no markings at all." There is confusion about the validity of this subspecies because nominate black individuals from outside northern San Diego County are often called *pacifica*. Schaupp was vague about the range of this subspecies, writing that, "It occurs intermingled with the type equally numerous on the ocean shore in San Diego, California."

Blaisdell (1892) collected *C. h. pacifica* at Del Mar, but added to the taxonomic confusion when he mistook the nominate form for *C. h. pacifica* and stated "From the sea-shore it extends up Penasquitos Creek for the distance of fourteen miles to Poway (700 feet)."

The beach area between Lecaudia and Solana Beach has nearly "pure" populations of immaculate blue *C. h. pacifica*. The adults and larvae inhabit the sides and bottom of the vertical sandstone bluffs which back the narrow sea beach. I observed adult tiger beetles actively hunting prey on the cliffs as high as 4.5 meters in the spring and summer. The larval burrows were seen dug in the sand which collects in the narrow cracks in the cliffs. No burrows were seen in the cliffs themselves because the sandstone is too hard for the insects to dig into. I observed no larval holes higher up than 1.5 meters.

I collected a Black Widow Spider (*Lactrodectus hesperus* Chamberlin and Ivie) and an adult *C. h. pacifica* caught in her web at Lecaudia beach. The victim was dead and had been wrapped in spider silk. *Lactrodectus* are fairly common along the bluffs and probably regularly prey on *C. h. pacifica* at this locality.

C. h. pacifica is always found within a few dozen meters of the open ocean. It is probable that the distinct blue coloration is the result of the influence of sea water or salt spray.

I am resurrecting the subspecific name *pacifica* because it occupies a well defined geographic range, it can be separated from other subspecies by its distinctive blue coloration and is ecologically distinct.

Cicindela haemorrhagica is generally found on sandy beaches in estuaries, tidal flats or the open sea beach. The nominate form prefers wet or damp areas in the Lower Zone. The subspecies *C. h. pacifica* can be found on the dry sandstone cliffs in the Upper Zone and less commonly on the adjoining beach. I have never encountered the nominate *C. h. haemorrhagica* on a coastal sandy cliff habitat.

Present Localities:

Cicindela haemorrhagica haemorrhagica

Santa Barbara County: Santa Cruz Island

Ventura County: San Nicolas Island

Los Angeles County: Venice Canal at Pacific Avenue; Ballona Creek at Marina del Rey

San Diego County: Chula Vista; Border Field State Park

Cicindela haemorrhagica pacifica

San Diego County: Carlsbad; Encinitas County Beach at Lecaudia; Cardiff by the Sea; Solana Beach; Del Mar; Black's Beach (Torrey Pines); La Jolla

Population Status:

The nominate subspecies is found throughout southern California, Nevada and the Pacific Northwest. It is in no danger from humans.

The subspecies *pacifica* occupies a very restricted range extending from Carlsbad south to La Jolla in San Diego County on the sea beaches. Northern San Diego County is currently undergoing a tremendous increase in human population and has, therefore, increasing numbers of people using the beaches. The largest populations of the beetle occur along the sandy beaches of Lecaudia and Del Mar.

The practice of removing the kelp wrack from the sandy beaches by the San Diego County Department of Parks and Recreation is extremely detrimental to *C. h. pacifica*. This tiger beetle is almost entirely dependent for food on the many arthropods that feed on the decomposing seaweed. I noted a large reduction in the size of the population at Lecaudia after the County of San Diego began the removal of the wrack.

Former Localities:

Cicindela haemorrhagica haemorrhagica

Ventura County: (Port) Hueneme; Santa Clara River; Point Mugu Naval Air Station Lagoon

Los Angeles County: Redondo (Beach); San Pedro; Los Angeles; Naples

Orange County: Bolsa Chica; Sunset Beach; Balboa; Seal Beach

San Diego County: Oceanside; San Diego

Cicindela haemorrhagica pacifica

San Diego County: I do not know of any reduction in the range of this subspecies.

Cicindela gabbi Horn

This tiger beetle occurs along the sea coast of southern California and northwestern Mexico.

Cicindela gabbi inhabits dark colored mud in the Lower Zone of estuaries and mudflats. I have seen it occasionally hunting prey on dry saline flats within estuarine areas. Fall (1901) stated that it is "...infrequent on the mud of salt marshes at San Diego and Wilmington in August and September and is rarely taken on the ocean beach." This species is attracted to lights at night.

Present Localities:

Orange County: Seal Beach Naval Weapons Station

San Diego County: Chula Vista; Silver Strand; Border Field State Park

Population Status:

The only locality where this species is common is at the Sweetwater River mouth in Chula Vista. Unfortunately, this area is subject to use by dirt-bike motorcycles. Stamatov (1972) felt that the disappearance of *Cicindela dorsalis* Say, an eastern beach species, was caused by extensive ORV activity in its habitat.

C. gabbi was found in small numbers at Border Field State Park (Nagano, 1980) and a nature preserve on Silver Strand. This species occurs in certain areas of the Seal Beach Naval Weapons Station in Orange County (E. Sleeper, pers. comm.).

Three specimens of *C. gabbi* have data indicating that they were collected at Point Mugu Naval Air Station in Ventura County (Pt. Mugu, California 9-VII-54 D. K. Duncan). I feel that they are mislabelled because the locality is too far north for this species (Nagano, 1979).

Former Localities:

Ventura County: Point Mugu Naval Air Station (questionable)

Los Angeles County: Wilmington; Naples; Long Beach

Orange County: Newport Beach; Huntington Beach; Balboa; Costa Mesa; Los Platos near Sunset Beach

San Diego County: San Diego

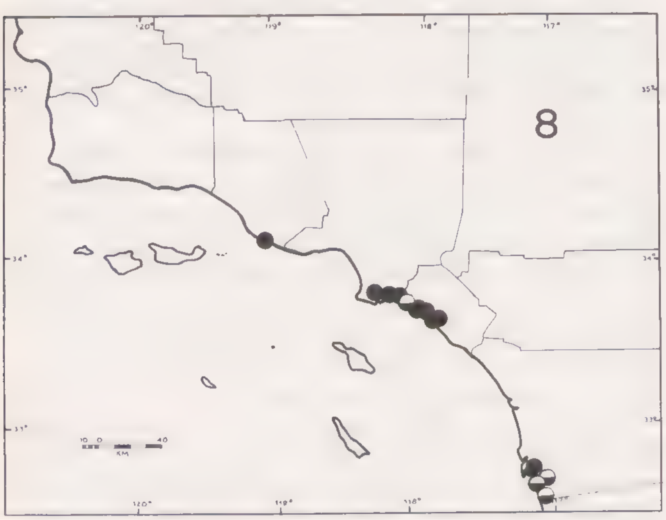

Figure 8. *Cicindela gabbi* Horn: ◒ present localities; ● recorded localities.

Cicindela tranquebarica Herbst

The records of *Cicindela tranquebarica* started with Blaisdell (1892) who stated that the subspecies *C. t. viridissima* Fall (called *vibex* Horn by Blaisdell) was found on the "ocean beach, near Oceanside." This data was also listed by Moore (1937) and Fall (1901). According to Rumpp (pers. comm.), "To my knowledge it never occurs on the ocean beach, yet Blaisdell mentioned that it did; he may have observed it on drier sandy places near estuaries where it may have existed at the time, but directly on the beach would be in error because that is not the habitat of that species. So far as I know, *viridissima* is now fairly restricted to the Santa Ana River basin, also fast disappearing from there because of human encroachment."

Because I have never collected this species along the seashore and do not know of any marine littoral populations, *Cicindela tranquebarica* must be considered a highly doubtful seashore tiger beetle.

Cicindela willistoni Le Conte

The single known coastal specimen is from Seal Beach in Orange County, and it is unquestionably mislabelled. The species is normally an inhabitant of the arid regions of the western United States. Willis (1967) also questioned the validity of this record.

The locality label of the specimen in the Natural History Museum of Los Angeles County states, "L. L. Muchmore Seal Beach 2702." I have examined Muchmore's notes and they show that the original data for this tiger beetle was "*(Cicindela) senilis* Fall LLM no data." Muchmore apparently crossed that out and changed it to "*(Cicindela willistoni) pseudosenilis* W. H. 64-6 Seal Beach." On the basis of these facts, the record must be considered invalid.

Cicindela nevadica Le Conte

A specimen in the Natural History Museum of Los Angeles County bears the locality label: "Long Beach April 11 '68 Jim Deene." This is a desert species that is found only in Kern, Inyo and San Bernardino Counties in California. The possibility of *C. nevadica* occurring such a great distance away from its normal ecotope is very doubtful. This is most probably a mislabelled specimen.

Conclusions

The majority of seashore *Cicindela* in southern California were found inhabiting state parks and military reservations. Large numbers were found at only eight localities. They are Point Mugu Naval Air Station Lagoon; Ballona Creek at Marina del Rey; Catalina Harbor on Santa Catalina Island; Newport Backbay; Lecaudia; Del Mar; Chula Vista and Border Field State Park. The continued suitability of Ballona Creek, Del Mar, Lecaudia and Chula Vista as habitats is in doubt due to human influence.

Border Field State Park in San Diego County has the greatest number of tiger beetles of any single locality along the southern California sea coast in terms of diversity and abundance.

I recommend the following actions be taken for the continued existence of southern California marine littoral *Cicindela*:

1. There are four seashore tiger beetles that are in danger of becoming eradicated within their range in the United States. They are *Cicindela gabbi*, *C. senilis frosti*, *C. latesignata latesignata* and *C. hirticollis gravida*. I recommend that they be listed by the federal government as Threatened Species.
2. *Cicindela latesignata obliviosa* is in danger of extinction or it may already be eradicated throughout its entire range. I recommend that it be placed on the federal Endangered Species list.
3. The *Cicindela* which might be threatened in the foreseeable future within their range in the United States are *Cicindela haemorrhagica pacifica* and *C. trifasciata sigmoidea*. I recommend vigilant monitoring of their population status.
4. The Sweetwater River mouth at Chula Vista in San Diego County should receive private or government protection as a critical habitat. This location is also inhabited by some federally protected birds. It is imperative that the ORV activity be stopped. This locality could be made into a nature preserve or a wildlife refuge.

5. The removal of kelp wrack by the San Diego County Department of Parks and Recreation should be stopped. Otherwise this practice will probably lead to the eradication of *Cicindela haemorrhagica pacifica*.

I have concluded that the tiger beetles of the marine shoreline were once widespread in southern California, but are now restricted to a comparatively few localities.

It is highly probable that without private or government protection these cologically important animals could be totally eliminated from their few remaining habitats along the sea coast of southern California.

Acknowledgments

I would especially like to thank Dr. Charles L. Hogue for his assistance with this study, reviewing the paper and for giving me unlimited use of the Entomology Section of the Natural History Museum of Los Angeles County. I am also grateful to Mr. Roy R. Snelling, Mr. Julian P. Donahue and Dr. Camm C. Swift for their help.

Conversations about the California Channel Islands, mainland localities and marine mammals with Mr. Scott E. Miller of the Santa Barbara Museum of Natural History were extremely enlightening. Scott, as well as Mr. Robert Perry, Mr. Kevin Cheesman and Ms. Cindy Gall provided welcomed company on collecting trips.

Dr. Norman L. Rumpp and Mr. William D. Sumlin, III gave me information on many tiger beetles and ideas that proved most intriguing and helpful. Dr. Rumpp let me have copies of his unpublished reports and these were invaluable for this project.

Dr. Mont Cazier (Arizona State University) and Dr. Robert Graves (Bowling Green State University, Ohio) gave me information on *Cicindela latesignata* and *C. hirticollis*, respectively.

Dr. Robert Given and Annmarie Ermatinger (University of Southern California) allowed me use of the marine station on Santa Catalina Island. Dr. Adrian Wenner (University of California at Santa Barbara) gave me permission to investigate Santa Cruz Island, Carpinteria salt marsh and Coal Oil Point. Mr. Phillips L. Claud (California Department of Parks and Recreation) gave me permits to survey state parks. Mr. Paul Campo (U. S. Marine Corps) gave me access to the mouth of the Santa Margarita River in Camp Pendleton. Mr. Andrew Mills (Bixby Ranch Company) let me collect at Point Conception.

Mr. Ron Dow (U. S. Navy) allowed me unlimited access to the Point Mugu Naval Air Station Lagoon and San Nicolas Island. Lt. Comm. David L. Houghton provided me with logistics while on San Nicolas Island.

Dr. W. Calvin Welbourn (Ohio State University) identified the mites from San Diego County.

I thank the following people for loans and/or records of coastal *Cicindela*: Dr. Richard Freitag; Mr. Ronald Huber; Dr. David Kavanaugh (California Academy of Sciences); Dr. Gary Stonedahl (Oregon State University); Dr. L. L. Pechuman (Cornell University); Dr. Carl Olson (Arizona State University); Dr. Lee Herman (American Museum of Natural History); Dr. Paul Spangler (U. S. National Museum); Dr. Quentin Wheeler (Ohio State University); Dr. Marilyn Pearce (Museum of Comparative Zoology); Dr. Robert Murray (Texas A & M); Dr. A. Smetana (Canadian National Museum); Mr. Don Misumi; Mr. Garin Ho; Mr. John Shetterly; Dr. Daniel Mahr (San Diego State University); Dr. Saul Frommer (University of California at Riverside); Dr. Dan Young and Mr. Gary Dunn (both of Michigan State University); Dr. Dave Pearson (Pennsylvania State University); Dr. Elbert Sleeper (California State University at Long Beach); Dr. Lanna Cheng (University of California at San Diego) and Dr. Arnold Menke (U. S. D. A.).

This study was funded by Mr. Henry Saito and the Xerces Society, an organization dedicated to the preservation of endangered invertebrates and their habitats.

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Recorded Host Plants and Nectar Sources of the Short-tailed Swallowtail (*Papilio brevicauda* Saunders) (Lepidoptera: Papilionidae) in Newfoundland, Canada

Bernard S. Jackson

Oxen Pond Botanic Park, Memorial University of Newfoundland, St. John's, Newfoundland, Canada, A1C 5S7

Abstract

Hostplants and nectar sources: New records of hostplants and nectar sources are presented for the Short-tailed Swallowtail (*Papilio brevicauda* Saunders) in Newfoundland.

The Short-tailed Swallowtail (*Papilio brevicauda* Saunders) is widely distributed in Newfoundland, southern Labrador, Quebec, the Maritime Provinces, on Anticosti Island, and on the shores of the Gulf of St. Lawrence (Morris, 1980). Klots (1951) recognized three subspecies, listing the Newfoundland and Anticosti butterfly as *P. b. brevicauda*. Emmel (1975) suggests that the three subspecies that are recognized differ very little and are of questionable value.

In Newfoundland the adults are on the wing from mid-June until late July. The round yellow eggs are laid singly on the dorsal side of the leaves of suitable host plants. Early instar larvae are brownish black with a white saddle and in this stage are said to resemble a bird's dropping (Klots, Morris, *et al.*). The older larva is green with a black band containing small round yellow spots across each segment. Though this coloration is definitely concealing amongst the food plant's foliage the larvae may be readily found by a practiced observer.

Adults are particularly common around the Newfoundland coastline and off shore islands where their favourite host plant, the Scotch lovage (*Ligusticum scothicum* L.) abounds. During the past ten years I have also recorded larvae on the native Angelica (*Angelica* spp.), Cow Parsnip (*Heracleum maximum* Bartram) and Hemlock-Parsley (*Conioselinum chinense* (L.) Britton, Sterns *et* Poggenburg) as well as on the alien Wild Parsnip (*Pastinaca sativa* L.). In the home vegetable garden larvae have been located on Celery, Curled Parsley, Parsnip, Carrot and garden Lovage.

On one occasion, hand-reared individuals released into the wild were observed ovipositing on Wild Chamomile (*Matricaria chamomilla* L.). The resulting larvae died before the second instar. In the summer of 1977, sizeable larvae were found on five out of seven Gas Plants (*Dictamnus albus*) located in our perennial border. Those that were not taken by flower spiders reached maturity and presumably pupated. Though Gas Plant is a known host plant for *Papilio cresphontes* Cramer, (Emmel, 1975) which does not occur in Newfoundland, I have yet to locate reference to this plant as a host for *P. brevicauda*. The Gas Plant is however extremely uncommon in the flower gardens of Newfoundland.

In comparison to some species of butterflies, the adults do not visit a wide variety of nectar sources. However, adults in the wild have been recorded utilizing the following: Common Dandelion (*Taraxacum officinale* Weber), Labrador Tea (*Ledum groenlandicum* Oeder), Blueberry (*Vaccinium angustifolium* Ait), Blue Flag Iris (*Iris versicolor* L.), Fly Honeysuckle (*Lonicera villosa* (Michx.) R & S), Wild Mustard (*Brassica kaber* (DC) L. Wheeler.), and Scent-bottle Orchis (*Habenaria dilatata* (Pursh) Hook.). In the home garden they have been observed feeding from the flowers of Creeping Phlox (*Phlox subulata* "Sunningdale Red"), Globeflower (*Trollius* spp.), Dutchman's Breeches (*Dicentra formosa*), Mossy Saxifrage (*Saxifraga caespitosa* Var), Single French Marigold (*Tagetes patula* "Naughty Marietta") and Chives (*Allium schoenoprasum*).

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Another Foodplant of *Erynnis tristis tristis* Bdv. (Lepidoptera: Hesperiidae)

John W. Johnson

Assistant Research Biologist, Museum of Systematic Biology, University of California, Irvine, California, USA

Abstract

Erynnis tristis tristis **Bdv. has been reared for the first time from** ***Quercus dumosa*** **Nutt; it is known to feed already on** ***Quercus agrifolia*** **Hees,** ***Quercus lobata*** **Nee',** ***Quercus douglassi*** **H. and A., and** ***Quercus suber*** **L.**

Neither Comstock, 1927, nor Holland, 1931, reports a foodplant for the Mournful Dusky Wing (*Erynnis tristis tristis* Bdv.). Thomas C. Emmel and John F. Emmel, 1973, review data accumulated since the earlier publication and report several species of oaks being known as food plants for the butterfly species, but in southern California only *Quercus agrifolia* Nee' is cited as its foodplant. Howell, 1975, lists *Quercus lobata* Nee', *Quercus douglasii* H. and A., *Quercus agrifolia*, and *Quercus suber* L. as known foodplants.

In the spring of 1979, I gathered new shoots of the season from Scrub Oak, *Quercus dumosa* Nutt., in a side canyon of Aliso Canyon in the Santa Ana Mountains of Orange County, along the Live Oak Canyon Road one-half mile east of Aliso Canyon Road. The oak shoots were being used as a food plant for several species of moths (reports now being published). In May the larvae reached maturity and pupated. Uneaten foodplant was allowed to remain in the cages to avoid disturbing the moth pupae.

On June 16, 1979, I found a fresh, perfect, recently-dead male *Erynnis tristis tristis* on the floor of one of the rearing boxes. It probably emerged from a pupa two days earlier and died of dehydration, perhaps June 14, or even June 15, 1979. Search of the foodplant revealed the empty chrysalis of the butterfly held between two cupped leaves loosely knitted together by silk along their edges. Examination of nearby leaves of the shoot revealed the old feedings of the larva of the butterfly.

This record constitutes a new known foodplant for *Erynnis tristis tristis* in California. It accounts for the author's observation of abundant populations of the species in the old groves of *Quercus dumosa* trees at the Gavilan Hills in Riverside County. There the species is common, the adults flitting up and down the dry washes left by the winter rains at the edges of the groves, pausing often to alight on tufts of large perennial grasses. In this way, probably, the sexes are brought together, the females, once mated, returning to oviposit on the *Quercus dumosa* foodplant, which in this area, is remote from *Quercus agrifolia*, the other foodplant known to be used in southern California. The reared *Erynnis tristis tristis* male is being deposited as a reference specimen in the collections of the Los Angeles County Museum of Natural History at Exposition Park.

Acknowledgments

The author wishes to thank Gordon Marsh, Curator, Museum of Systematic Biology, his staff and librarians for their generous assistance in preparation of this manuscript.

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A New Foodplant for *Satyrium tetra* (Edwards) (Lepidoptera: Lycaenidae)

John W. Johnson

Assistant Research Biologist, Museum of Systematic Biology, University of California, Irvine, California, USA

Abstract

***Satyrium tetra* (Edwards) was reared from a wild larva on *Quercus dumosa* Nutt. in the Santa Ana Mountains. Its only reported foodplant heretofore was *Cercocarpus betuloides* Nutt. The larva was present on the *Quercus dumosa* shoots when these were gathered, producing in due time a perfect male.**

Comstock, 1927, states the foodplant of the Mountain Mahogany Hairstreak (*Satyrium tetra*) (Edwards) to be *Adenostoma (fasiculatum* H. and A. or *sparsifolium* Torr.). His comments suggest *fasciculatum*, the more common of the two, although he comments that the early stages are undescribed. Holland, 1931, likewise notes the early stages to be undescribed. Thomas C. and John F. Emmel, 1973, call attention to the fact that the foodplant is now known to be Mountain Mahogany (*Cercocarpus betuloides* Nutt.). Howell, 1975, notes *Cercocarpus betuloides*, and possibly *Cercocarpus minutiflorus* Abrams as foodplants.

In the spring months of 1979 I gathered tender shoots of the growth of the new season from *Quercus dumosa* Nutt. to feed several moth species whose larvae I had in rearing. As the shoots of plants at lower elevations became too mature, I drove to higher elevations to find plants that were more retarded by the cooler temperatures there. My last collections in May were made along Highway 74, the Ortega Highway, between Lake Elsinore and San Juan Capistrano at an elevation of about 850 meters and about 0.8 kilometers west of the summit sign. Here a large thicket of Scrub Oak, *Quercus dumosa*, offered tender shoots of the proper condition. These were gathered and distributed in the rearing boxes at home, where the moth larvae soon pupated. The foodplant was left in the boxes for some days in order to prevent damage to the transforming larvae and new pupae.

While the foodplant remained there, the cut stems in water, it remained fresh for many days, the rearing containers being outside and getting sun late in the afternoon.

I was surprised to observe one day about five days after gathering the foodplant to find a larva attached to the ceiling (in a corner of the box) by a silken belt and an anal silk button. By the following day it had transformed into a somewhat green pupa closely appressed to the surface, later becoming yellowish and finally dark before emergence. The adult male emerged on June 5, 1979, a perfect male specimen of *Satyrium tetra*. As no *Cercocarpus betuloides* was nearby, and as the larva evidently fed for some days before reaching the prepupal condition and crawling off the foodplant to pupate on the box surface, it undoubtedly was using the tender shoots of the *Quercus dumosa* as a foodplant. This observation establishes another plant species within the list of those the butterfly may utilize in nature. In view of the recent study of Walsh, 1977, on the utilization of *Quercus lobata* Nee' by the California Hairstreak (*Satyrium californica*) (Edwards) in the Great Central Valley of California, it may not be surprising that other members of the Genus may utilize oak as a foodplant also. The specimen is being deposited in the collections of the Los Angeles County Museum of Natural History as a confirmatory record.

Acknowledgments

The author expresses his gratitude to Gordon Marsh, Curator, Museum of Systematic Biology, his staff and librarians for their generous assistance in preparation of this manuscript.

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Within - Range Butterfly Dispersal: An Urban Garden as a Detector

Arthur M. Shapiro

Department of Zoology, University of California, Davis, California 95616, USA

Abstract

An urban butterfly garden situated in Davis, California, provided data demonstrating frequent individual dispersals of *Phyciodes campestris* (4.8 km), *Battus philenor* (3.2 km), and *Adelpha bredowii* (22.4 km) (minimum distances from breeding populations) and rarer dispersals by numerous other species. The frequency of both colonizations and effective gene flow among butterfly populations may be systematically underestimated due to the difficulty of detecting relatively rare events.

The amount of interpopulational dispersal in butterflies is exceedingly difficult to document. Ehrlich and Raven (1969) argued that such movement was too rare in organisms generally, and in *Euphydryas editha* in particular, to tie species together by gene flow as envisioned by Mayr (1963) in his landmark book. Although they marshal a substantial number of studies supporting their position, Ehrlich and Raven failed to convince many biologists, basically for two reasons. First, gene flow may occur not as the steady trickle envisioned by Ehrlich and Raven but as infrequent and massive episodes associated with population release (Shapiro, 1970). This is a classic inductive problem in which long runs of negative evidence are liable to overthrow at any time. Second, studies of dispersal in plants and non-mass-migratory animals are usually inherently biased against detection of long-range individual movements. Let us assume that there is a small but finite probability of an individual of a non-migratory species dispersing some long distance—perhaps one to three orders of magnitude greater than the distance dispersed by an average of its species in its lifetime. Even if it is possible to mark the organisms without adversely affecting their probability of recapture, and even if bait stations can be used to minimize the randomness of search for them, the area to be covered and the numbers one needs to mark rapidly render the study prohibitively expensive for the chances of success. For insects, the study of Bishopp and Laake (1921), in which pest flies were recovered 27 km from the release point, stands virtually alone; here numbers were almost unlimited and bait stations were very effective. For butterflies, no comparable data—or opportunities—seem to exist. Shields (1968) and White (1980) have demonstrated moderate-range individual dispersals by hilltopping male *Papilio zelicaon* and among peaks by *Euphydryas anicia*, respectively. Conventional mark-release-recapture studies, such as those of Arnold (1980) on various endangered butterflies, readily document "trivial" movements within a defined study area, but it is normally infeasible to document individual long-range dispersal beyond that area.

This is not to say that records documenting individual long range dispersal are lacking. Most are based on "strays," individuals collected or observed at sufficient distances beyond their normal species ranges that they attracted notice. Most detailed regional lists contain a number of these, and they may be quite spectacular, such as *Phoebis philea* in New York State (Shapiro, 1974c) or in Colorado (Ferris and Brown, 1981). Less spectacularly, Shapiro (1973, 1974a) documented nine non-migratory altitudinal dispersers in the mid-elevation Sierra Nevada of north-central California. In the Sacramento Valley, I found (1974b, 1975) five foothill species which must have dispersed more than 32 km—*Speyeria callippe, Zerene eurydice, Pieris sisymbrii, Euchloe hyantis,* and *Plebeius icarioides*, and (1977) one montane species, *Pieris occidentalis*, which seems to have had a minimum dispersal distance of 80 km. The occurrence of distinctive seasonal phenotypes permits the recognition of altitudinal dispersal in *Colias eurytheme* and *Pieris rapae* in the Sierra (1973) and latitudinal dispersal of *C. eurytheme* in upstate New York (1974c), but long-range dispersers within a climatic regime would be undetectable in a sea of their own species; a *Pieris rapae* could fly from Bakersfield to Redding without anyone noticing anything odd about it.

Since 1972 I have maintained a "butterfly garden" at my residence in north-central Davis, Yolo County, California, in the central Sacramento Valley. The immediate environs are typical modern Californian residential, landscaped with a limited variety of exotics, few of which are attractive to butterflies (the shrub *Escallonia*, Zinnias and Marigolds, and weedy dandelions are the principal exceptions); the garden is 0.8 km from a drainage ditch which supports late-summer populations of weedy species and about 2 km from the nearest "valley grassland" vegetation (to the NE and NW). It is planted in both nectar sources (especially *Solidago, Aster, Eriogonum,* and *Ceanothus*) and host plants (which have included *Asclepias, Sida, Rumex*, etc.), and includes an extensive area of bunch-grass with some admixture of weedy species. The effect of this garden is to detain any butterflies dispersing randomly through the neighborhood until I am likely to see them; I observe the garden several times daily in good weather, year-round. In ten field seasons 37 species (57.7% of the total Sacramento Valley butterfly fauna, Shapiro, 1974b) have been seen there, and at least 12 have bred. There are three other effective "butterfly gardens" on the campus of the University of California at Davis and a fourth in the east-central part of town. These are all visited from time to time but have yielded no additional species.

Table 1 lists all of the species recorded in the garden and provides estimates of minimal dispersal distances for some of

Table 1. Butterfly species observed in a garden at Davis, California, 1972-1981.

	Species	Frequency/ 10 yrs.	Distance to nearest source population
1.	*Danaus plexippus* * (M)	10	——
2.	*Phyciodes mylitta* #	10	< 1 km
3.	*Phyciodes campestris*	4	4.8 km
4.	*Vanessa annabella* * #	10	——
5.	*Vanessa cardui* * (M) #	8	——
6.	*Vanessa virginiensis*	9	3.2 km
7.	*Vanessa atalanta* @	10	——
8.	*Nymphalis antiopa* @	7	——
9.	*Nymphalis californica* (M)	5	>32 km
10.	*Polygonia satyrus*	2	18 km
11.	*Precis coenia* @	10	< 1 km
12.	*Adelpha bredowii*	6	>22.4 km
13.	*Coenonympha tullia california*	1	>10 km?
14.	*Lycaena helloides* * #	10	——
15.	*Plebeius acmon* #	10	< 1 km
16.	*Everes comyntas* * #	8	——
17.	*Celastrina argiolus echo*	2	>22.4 km
18.	*Brephidium exilis* #	9	——
19.	*Atlides halesus* @	5	——
20.	*Strymon melinus* * #	10	——
21.	*Pieris rapae* #	10	< 1 km
22.	*Pieris protodice* #	4	——
23.	*Zerene eurydice*	1	>32 km
24.	*Colias eurytheme* * #	10	——
25.	*Papilio zelicaon* # @	6	6.5 km?
26.	*Papilio rutulus* @	10	——
27.	*Battus philenor*	8	3.2 km
28.	*Heliopetes ericetorum* (M)	2	——
29.	*Pyrgus communis* * #	10	——
30.	*Pyrgus scriptura* * #	8	——
31.	*Erynnis tristis* * @	9	——
32.	*Pholisora catullus* #	8	——
33.	*Hylephila phyleus* * # @	10	——
34.	*Atalopedes campestris* #	9	——
35.	*Ochlodes sylvanoides*	5	3.2 km?
36.	*Polites sabuleti* #	5	——
37.	*Lerodea eufala* * #	10	——

Notes: * species which have bred in the garden.
(M) regular seasonal migrant.
"weedy," vacant-lot species generally distributed in area by late summer.
@ species breeding on cultivated plants or mistletoe on street trees.

Table 2. Records of six dispersers observed in a garden at Davis, California, 1972-1981.

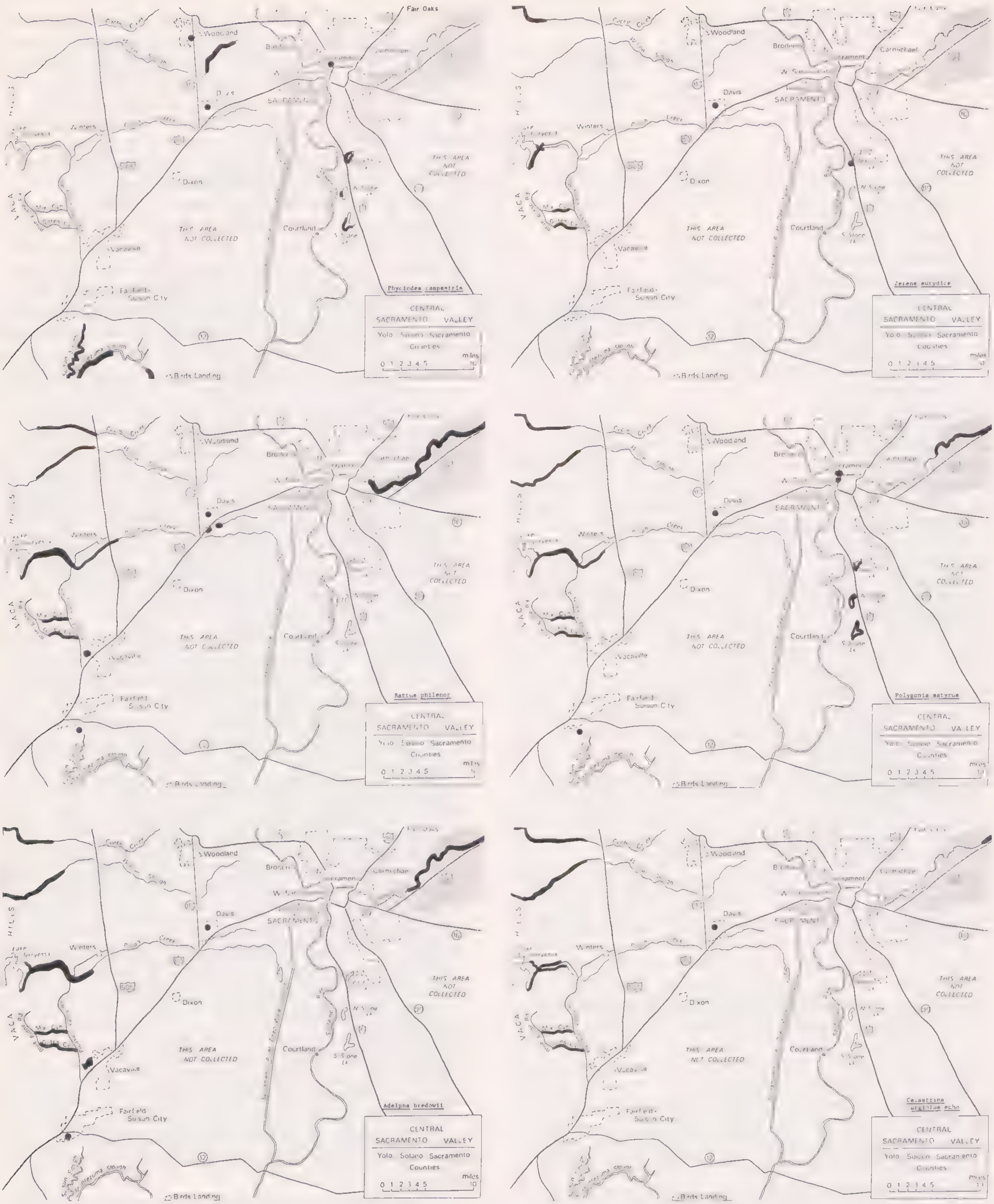
Zerene eurydice: 26 April 1972 (1)
Celastrina argiolus echo: 7 June 1972; 9 June 1981 (2)
Polygonia satyrus: 14 June 1974; 27 March 1977 (2)
Adelpha bredowii: 25 Oct. 1972; 25 May, 30 May, 1 Sept., 27 Oct. 1974; 4 June 1976; 23 Aug. 1978; 20 May 1979; 3 June, 5 June 1981 (10)
Phyciodes campestris: 14 May, 14 Sept. 1972; 23 May, 3 Sept., 3 Oct., 15 Oct., 12 Nov. 1974; 7 Oct. 1978; 9 May, 23 Oct. 1981 (10)
Battus philenor: 24 Mar., 13 April, 29 July 1972; 22 May, 23 July 1973; 10 Oct. 1974; 8 June 1975; 27 Aug. 1977; 8 June 1978; 25 April, 20 May, 7 Sept., 11 Sept. 1979; 17 April, 25 June, 2 July 1981 (16)

the species. Much of the Valley fauna consists of weedy, colonizing, or fugitive species which appear to have no "permanent" populations, as pointed out by Shapiro (1974d) for *Plebeius acmon*; no minimum dispersal distances are given for these. Only a few species, such as *Phyciodes campestris*, are genuinely colonial on the Valley floor, and for these estimates can be given. Some species recorded in the garden are non-resident on the Valley floor but occur in riparian canyon-bottom habitats in the Coast Range foothills to the west and the Sierra Nevada foothills to the east. Davis is nearly equidistant between these localities; again, minimum dispersal distances can be estimated. Only 14 species, all weedy, have been recorded in the garden in all ten years. Table 2 presents actual records for six species of particular interest, and Figs. 1-6 show the locations of the nearest potential source populations of these species. Three of them (*Celastrina argiolus echo, Zerene eurydice, Adelpha bredowii*) are not known to breed at this time on the Valley floor. *Battus philenor* has two very small relict populations on Putah Creek about 3.2 km SW of Davis. *Polygonia satyrus* has a breeding population at Discovery Park in North Sacramento. *Phyciodes campestris* has been carefully mapped in the Valley; its nearest population is at Willow Slough, 4.8 km NNE of the garden. The records in Table 2 are for the one garden only; in fact, *B. philenor* and *P. campestris* have been observed in Davis all 10 seasons, and *A. bredowii* in eight. On the other hand, *Lycaena xanthoides* has bred in all ten years as close as 3 km NNE of the garden, but has never been seen there at all. *Atlides halesus* is constantly present in the neighborhood, breeding on mistletoe in ash trees, but is very rarely observed at garden level.

What do these data tell us? Butterflies are apparently constantly on the move through adverse habitat. This is not surprising for the weedy vacant-lot species like *Hylephila phyleus* (I. Shapiro, 1975), *Plebeius acmon, Everes comyntas, Pyrgus communis*, etc., which have no "permanent" populations, but only ephemeral local manifestations of a floating "metapopulation" (Gill, 1978) of vast extent; nor for *Pieris protodice* (Shapiro, 1979), which has "refuges" from which it expands to occupy more or less territory on a temporary, seasonal basis. For such species it is easier to document the turnover of local "populations" than individual dispersal, and the two are basically equivalent. *Phyciodes campestris*, whose range in the Valley is narrowly defined by the disjunct range of its host, *Aster chilensis*, is another story. In ten years I have seen one colonization of an isolated patch of the plant, which died out after four years. Interestingly, there has been no breeding in the garden although there are several vigorous clumps of the plant. In the San Francisco Bay Area and the montane Sierra Nevada *P. c. campestris* and *P. c. montana* respectively are relatively ubiquitous, as are their hosts.

The frequent occurrence of *Adelpha bredowii* at Davis, midway between its two sets of foothill populations, suggests that for it, the Valley may not constitute a barrier to effective gene flow. It definitely does for *Euphydryas chalcedona*, which is phenotypically different in the two ranges and which has been taken once at Putah Creek but never within the Davis city limits.

Is dispersal density-related? *Phyciodes campestris* is trivoltine at Willow Slough, and its flights have varied between several hundred and 10-20,000 individuals (Shapiro, unpublished data). The garden data are too sketchy to permit correlation. They are all of the spring and fall flights, though the summer is



Figures 1-6. Distributions of six species near Davis. The garden is indicated by a dot within the Davis city limits; blackened areas are breeding populations; stippling indicates dredge-tailings habitat. A few individual records from other non-breeding areas are indicated by dots. 1 mi = 1.6 km.

sometimes the most abundant; summer strays have been seen elsewhere in the area. My impression is that good *B. philenor* years at Putah Creek produce more sightings in town. Whether or not emigration from breeding areas is a density-related response, however, the frequency of dispersal over distances up to more than 20 km as documented here suggests we should not be too hasty in discounting gene flow as a significant factor in butterfly evolution. Animals leaving the breeding colony are presumably dispersing in all directions, not making a beeline for my garden; so we are seeing the substantial tip of what must be a very much more substantial iceberg.

Acknowledgments

This ongoing study, if it can be called that, depends upon the goodwill of my wife, Adrienne Austin Shapiro, and my neighbors on Mills Drive and Beech Lane in Davis, who have tolerated some very aberrant landscaping for over a decade. To all, many thanks.

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An Extinct Population of a Third Species of Southern California Satyrid (Lepidoptera: Satyridae)

John W. Johnson

Assistant Research Biologist, Museum of Systematic Biology, University of California, Irvine, California 92717, USA

Abstract

In March, 1961, the author observed a large dark brown satyrid with cryptic light and dark brown wing under surfaces, showing no obvious spots. The butterfly was seen in flight along the north edge of East Bluff Terrace, Upper Newport Bay, Newport Beach, Orange County, California. From 1961 until the destruction of the habitat in the autumn of 1971, only one other such butterfly was seen, in April, 1969. Both individuals differed in size and color and emergence period from the two satyrid species previously recorded from southern California: *Coenonympha california california* **Westwood and** *Cercyonis sthenele sylvestris* **(Edwards). These sightings constitute a new species observation for southern California that should be permanently recorded in the literature of California Lepidoptera, even though the identity of the taxon remains undetermined.**

The spring of 1961 was early, with wildflowers blooming from late February, following the driest twelve-month period (7.67 centimeters of precipitation) in Corona del Mar that the author has recorded in 28 years. One afternoon in late March the author flushed a large, dark brown satyrid butterfly, nearly as large as a male *Nymphalis antiopa antiopa* (L.), from vegetation at the west end of the north bluff of the East Bluff Terrace of upper Newport Bay in the city of Newport Beach, Orange County, California (Figure 1). The butterfly flew off eastward on the westerly breeze, its bounding, bobbing flight unmistakably that of a satyrid. It was too early in the season and too large to be *Cercyonis sthenele sylvestris* (Edwards), a summer species in the mountains of the county, and utterly unlike the small white *Coenonympha california california* Westwood, the two species recorded from Orange County (Orsak, 1977) and southern California (Emmel and Emmel, 1973). Sufficient glimpse was afforded to show no obvious spots on the lower sides of the wings, although a mottled, cryptic pattern was visible. Efforts were made to pursue the butterfly even though the author lacked collecting equipment at the time, but it vanished without a further sighting.

During subsequent years the author repeatedly visited the top and slopes of the north bluff during spring but no more satyrids were seen. In April, 1969, the author again visited the north bluff about 10:00 AM for gathering of plant specimens. Suddenly, from a narrow strip of ungrazed native grasses below the brink of the terrace edge, a large, dark brown satyrid flew up, of similar size and markings as the one seen in 1961. It bobbed away into the westerly breeze along the terrace edge, again disappearing suddenly, probably by alighting. A search for it was unsuccessful. No other individuals were seen. In April, 1970 and April, 1971 the butterfly was sought again without success.

In the autumn of 1971 leveling began for the construction of homes along the north bluff of the terrace, totally eliminating

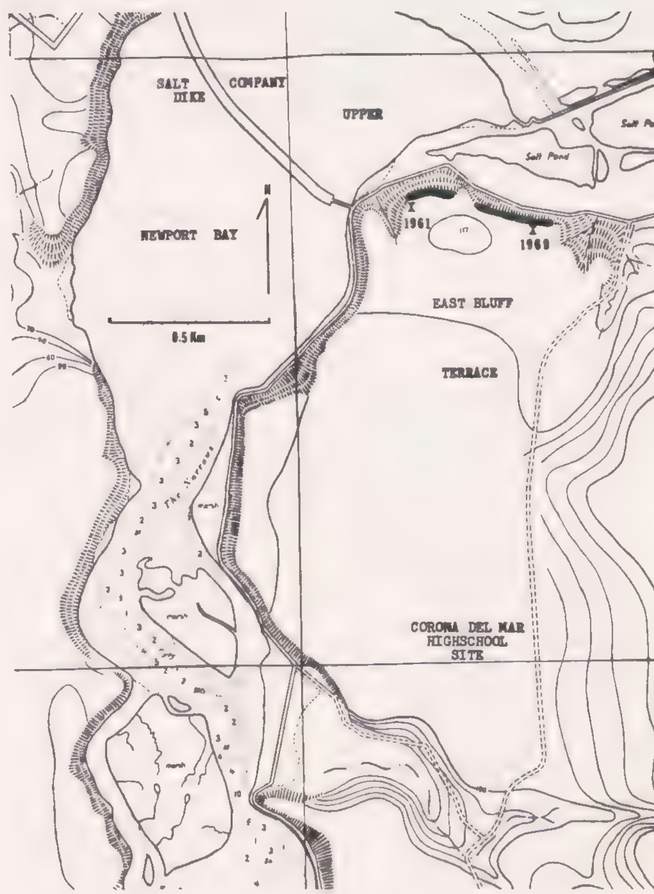

Figure 1. Upper Newport Bay (part) showing locations (x) and dates where a satyrid butterfly was seen. The strips of native grassland serving as the butterfly habitat are stippled.

the narrow strip of native grasses that had served, apparently, as a habitat for the satyrid. This ended any possibility for the continued survival of the population.

What was the satyrid? As none were caught, we shall never know, other than that it represented a third Orange County species which survived within the protected lands of the Irvine Ranch for more than a century after most of Orange County had been developed. The species resembled *Cercyonis pegala boopis* (Behr) (Emmel, 1975) in size, coloration, and behavior. Existing colonies of *boopis* are known as far south as Carmel, California, approximately 570 km. north of Newport Beach (*fide* James R. Mori, Ralph E. Wells). There the species is associated with a coastal marsh. Moreover, Comstock (1927) figures Washington State specimens of *C. p. boopis* collected in April. It is possible that *boopis* colonies once existed at favorable sites farther south than those presently known, and that the population of Upper Newport Bay was a relict population of this species. However, the sightings could have represented a relict colony of an unnamed taxon limited to southern California, which vanished with the introduction of European grazing livestock and European weeds that have agressively replaced much of the native California lowland flora. That the species was rare and the colony much diminished is evident from the author's failure to observe more specimens for eight years. Since searches in 1970 and 1971 were unsuccessful, 1969 may have been the last year in which a viable colony existed.

The colony on the ungrazed steep slope of the north edge of the East Bluff Terrace, having survived into recent years, may have been this butterfly's last holdout.

However, existence of the unidentified satyrid of Newport Bay suggests that other populations may yet survive on the California or Baja California coasts in localized habitat remnants. If so, their early discovery and protection is a matter of urgency as the coastline is undergoing rapid urbanization that threatens remaining natural areas.

Acknowledgments

The author wishes to express his gratitude to Gordon Marsh, Curator, Museum of Systematic Biology, University of California, Irvine, and his librarians and staff for their assistance in the preparation of this manuscript, and to James R. Mori and Ralph E. Wells for their information on the distribution of *Cercyonis pegala boopis*.

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Notes

Postscript to the British Issue, *Atala* 7 (2)

Response to *ATALA* 7(2) having been very positive, it was felt that readers might appreciate these brief notes on recent developments and related matters.

BRITISH BROCHURES. The editor has now attended two Annual General Meetings of the British Butterfly Conservation Society, at which it was decided that reciprocal BBCS/ Xerces mailings would be mutually beneficial. As the first part of this arrangement, a pair of British butterfly brochures is being included in a regular posting to Xerces Society members. The first of these is the BBCS broadside, an attractive sheet picturing the Large Blue and giving essential information about the Society and its goals. The second is a full-color, eight-side foldout pamphlet entitled "Butterflies: an introduction to their conservation." This very beautiful publication contains ten superb color photographs of some of Britain's rarer and/or more spectacular species, as well as a valuable text by Robert Goodden and Jeremy Thomas. Robert Goodden also took the photographs and designed the brochure. Its purpose is to introduce Butterfly Year 81-82, and to let people know how they can take part in conserving British butterflies. Both brochures were made available free of charge to Xerces by BBCS and the Butterfly Year Committee. As soon as the new Xerces Society brochure (now being designed) is available, it will be supplied to BBCS for mailing to all members of our sister society. (Note: if Xerces members wish to join BBCS but experience difficulty in payment of dues in Sterling, they may send payment in US$ to the Xerces Treasurer (Stephen Chang, 304 West 236th Street, Bronx, NY 10463) who will then transfer them *en masse*.)

ANOTHER NCC BOOKLET. We gave notice in *ATALA* 7(2) of booklets produced by the Nature Conservancy Council covering the conservation of bees and wasps, dragonflies, and snails, slugs and fresh water molluscs. Another such booklet has been brought out by NCC as part of that agency's contribution to Butterfly Year. Entitled *The Conservation of Butterflies*, it is well illustrated in both color and halftone and contains a valuable summary of the subject in the U.K., written in an interpretive style. (See ATALA ABSTRACTS in this number for more details.) The booklet may be obtained from NCC, Interpretative Branch, Attingham Park, Shrewsbury SY4 4TW, England, along with the other titles. The price of each is £0.40 (=$0.72) plus £0.40 postage and packing per £1.00 of order. So for £2.40 ($4.32) all four booklets may be had. Extra for airmail, and please pay by International Money Order in Pounds Sterling.

BUTTERFLY YEAR 81-82. After a quiet winter, Butterfly Year is off to a very energetic start for its final summer season.The results of Butterfly Countdown, a project of the Royal Society for Nature Conservation's WATCH program for children, will be reported at a later date; first indications are that this was a success, raising butterfly awareness and bringing in some valuable data. A major spring event in London, the Daily Mail Ideal Home Exhibition adopted butterflies as its 1982 theme. In addition to an amazing array of butterfly motifs on display by home furnishings manufacturers and designers, there was an exhibition of living butterflies, interpretive materials and conservation information put on by Robert Goodden and Worldwide Butterflies, Ltd. Nearly a million people are expected to have been exposed to butterflies and the need for their conservation at the Ideal Home Exhibition. Also during butterfly year, the Royal Society for the Protection of Birds has acquired a new reserve containing important habitat for the endangered Heath Fritillary (*Mellicta athalia*) in Blean Wood, Kent. Prince Charles, Duke of Cornwall, has ordered strong new conservation measures in sensitive parts of the Duchy of Cornwall—including the restoration of a coniferous plantation to prime habitat for the Heath Fritillary. The rare butterfly would have been displaced as the conifers matured, but should now be able to survive due to the Prince of Wales' concern. Meanwhile, Jeremy Thomas and others are engaged in detailed surveys of this and other rare species to determine necessary conservation and management measures to save them. If they have their way, there will be no more extinctions like that of the Large Blue. Butterfly Year should prove immensely helpful to the campaign. Donations have been coming in for Butterfly Year in good numbers, although much more money is required to meet all of its goals. It is hoped that one or more reserves can be bought where people can view an abundance of common butterflies in order to build awareness. The individual county naturalists' trusts are being encouraged to purchase locally significant butterfly habitats as their contributions to Butterfly Year. We will publish a full report on Butterfly Year 81-82 following its conclusion, probably in *WINGS*.

WILDLIFE AND COUNTRYSIDE ACT BECOMES LAW. Since the British number of *ATALA* was produced, the Wildlife and Countryside Law has passed both houses of Parliament and been signed into law. A much-compromised bill, over 1000 amendments were offered on the floor in order to stall and weaken it by parliamentary opponents. At a recent meeting of the Joint Committee for the Conservation of British Insects, the implications of the Act for entomology were discussed. It was felt that strict interpretation of the act would see most entomologists as lawbreakers, since provisions apply far more broadly to "taking" or possessing specimens than to any real habitat measures for rare species. Certain invertebrates listed by the Act as being fully protected were thought to be inappropriately so, such as the British swallowtail (*Papilio machaon*) which was added likely due to its renown; and several snails that may be identified only through dissection. The major habitat-related provision calls for reimbursement to farmers for losses incurred by agreeing not to damage Sites of Special Scientific Interest—a scheduled, but otherwise unprotected category of land. Some conservationists argue that farmers should not have to be paid off to be good land stewards, others worry that government appropriations will be inadequate to pay for the expected flood of applications for compensation. An article by Norman Moore, entitled "What parts of Britain's countryside must be conserved?" (*New Scientist* 21 January 1982), explores the rationale

behind SSSIs and the likelihood of maintaining them under the new legislation. Alan Stubbs of the Nature Conservancy Council prepared a memo on the relation of the Act to insects and their conservation. It is clear that it will be some time before all of its ramifications are known, and conservationists are hoping that it will provide at least some comfort and strength at a time when environmental matters are decidedly in the background of governmental thinking and spending. The JCCBI passed a resolution pertaining to the Act, the text of which is reproduced here:

> The Joint Committee for the Conservation of British Insects *welcomes* the initiative taken by Government in the intention to improve the conservation of insects in the Wildlife and Countryside Bill. It *draws attention* to the accelerating destruction and alteration of habitats which are the chief cause of extinctions and delines in the British fauna and *emphasizes* that if better protection of sites is to be achieved adequate public funds must be allocated to the purpose.
>
> The Committee *deplores* the mere scheduling of species as endangered by Government agencies without the concomitant implementation of any recovery programmes, and *stresses* the importance of satisfactory management of sites and recognition of a minimum carrying capacity ('critical habitat') in areas set aside for the conservation of each endangered species.
>
> The Committee *pledges its support* to the statutory and voluntary conservation bodies in the continuing struggle to conserve Britain's insect fauna. It *recognizes* the need for better survey, monitoring, research and education and will *continue to contribute* to each of these fields. October 13, 1981.

JOHN HEATH RETIRES? A member of the Xerces Society's Board of Directors and long-time pillar of the British butterfly conservation movement, John Heath, has retired from his post as head of the Biological Records Centre, Institute of Terrestrial Ecology. In recent years John founded the European Invertebrate Survey and the International Commission for Invertebrate Survey, and conducted a major study of "Threatened Rhopalocera in Europe" for the Council of Europe (see ATALA ABSTRACTS). His early activities following retirement do not suggest much of a slowdown. These include taking on the Presidency of the British Entomological and Natural History Society, and organizing the Third European Congress of Lepidopterology, to be held in Cambridge from April 13-16, 1982. The Xerces Society adds its best wishes to those of his many friends and colleagues, for John Heath upon his "retirement."

Robert Michael Pyle, Swede Park, Loop Road, Box 123, Gray's River, Washington 98621, USA

Book Reviews

These brief reviews are intended to present and describe recent books that may be of use and interest to *ATALA* readers. Fuller reviews dealing with their technical merit and quality of content in much greater detail will appear in other journals. Book notices of this type, stressing any conservation material they may contain, are cordially solicited by the editor. Longer reviews of books concerned largely with ecology and conservation of invertebrates will also be favorably considered for publication.

The Audubon Society Field Guide to North American Insects and Spiders. **Lorus and Margerie Milne (1980). A. A. Knopf, New York. 989 pp., 702 color plates and many drawings. $11.95; softcover.**

A major addition to the insect natural history library, this member of the richly illustrated, vinyl-bound Audubon series of field guides must be welcomed by all who enjoy insects. Its large number of excellent photographs from nature, superbly printed, offer much pleasure in their own right. The interpretive text by the much-published Milnes takes one on a very useful survey of the commoner insects of the continent, introducing all of the orders and many families as well as prominent groups of arachnids. These are all introduced textually, followed by the species accounts arranged systematically. Each one includes a description, habitat, range, food, life cycle, sound if appropriate, and natural historical comments. While the text is well edited and worthwhile, the plates really distinguish the book. These are arranged largely by looks, juxtaposing, for example, bees and flies. Inevitably, this will delight beginners and irritate entomologists. A cleverly designed system of thumb-tabs helps to locate the type of insect in the hand, in the book. It would be too much to say that one will actually identify most of the insects one encounters down to species using this tool, but the ball park is the thing. Nonetheless, a surprising number of the more distinctive species can be pegged with it.

A tremendous opportunity in conservation education was lost when the very solid conservation section prepared by the Milnes (and reviewed by this editor) was dropped, for reasons of space. This book is destined to sell many thousands of copies through successive editions. Its capacity as a vehicle to raise insect conservation awareness was vast. The axing of the conservation section was a tragedy from Xerces' point of view. This is especially galling when one considers the space taken for wing venation drawings and explanations, unnecessary at this level of interpretive entomology. A fine learning and field tool, this elegant guidebook would come wholly recommended but for its unnecessary conservation illiteracy and self-destructing binding. Perhaps the publishers can be urged to reinstate the conservation text in a future printing. They would do themselves and the subject more justice by doing so, and make the book more interesting as well. At least the authors are to be commended for addressing conservation so well in their draft. It comes through in a few spots in the text, such as the mention of the Giant Carrion Beetle (*Nicrophorus americanus*) on p. 550, once common, now perhaps extinct.

Naturally, such an ambitious book must be highly selective in the species it chooses to cover. The choice is an apt one, it seems, although any specialist could quibble. Elementary field entomology and insect enjoyment will be well served by this new book.

Butterflies of the Rocky Mountain States. **Clifford D. Ferris and F. Martin Brown (1981), editors and contributors; other authors: J. Donald Eff, Scott L. Ellis, Michael S. Fisher, Lee D. Miller, James A. Scott and Ray E. Stanford. University of Oklahoma Press, Norman. 442 pp., 4 color plates, many halftones, 314 maps. $35 cloth, $15.95 paper.**

As sequel and successor to F. M. Brown, J. D. Eff and B. Rotger's *Colorado Butterflies* (a classic, and bible of the editor's youth), this book has long been awaited. And well it might have been: a grand study, this is in many ways the best regional butterfly book since Scudder's New England masterpiece of 1889.

Difficulties in production resulted in the malcorrection of many errors in proof. These, we are assured, will disappear in an early second printing. They will not be taken into account here. Extensive introductory material, instead of the usual gratuitous paragraphs, treats Biogeography (with habitat photographs), Bionomics, External Anatomy, Taxonomy and techniques in worthwhile detail. Scott Ellis's excellent discussion of biogeography includes a substantial section on conservation, concluding with a nice plug for the Xerces Society (of which most of the authors are active members). Scott's well written conservation essay confirms that no butterfly species extinctions have taken place in the Rockies over the past century, but that many range contractions have been documented and certain species are now greatly restricted. He attributes habitat losses to climatic change, agricultural development and grazing, introduction of aliens (possibly overstated with respect to the cabbage white, *P. rapae*) urbanization and industrial development, and mining and damming. Scott rightly portrays the radical habitat changes along the Colorado Front Range, especially around Denver; and names as most threatened habitats the remaining wetlands, native prairies and riparian areas. Although no Rocky Mountain butterflies have been formally listed by the Office of Endangered Species, an initial list of species under consideration and in need of further study

contained *Speyeria nokomis* sspp. and *Cercyonis meadii alamosa* in the possibly threatened column.

The individual species accounts include detailed nomenclature, diagnostic features, range and habitat, and bionomics. Few words are wasted and the language is surprisingly clear and consistent for a book with so many cooks. Halftone photographs, both dorsal and ventral, accompany each species account. These have not improved on the old *Colorado Butterflies* pictures for clarity, although they depict more views and variations. In some cases the photos could be clearer and larger (the minute, muddy *Nathalis iole* (dorsal only), on a page with lots of empty space, exemplifies), but on the whole they serve their purpose. The four color plates set out a representative array of species and have been quite well executed. More color, including field shots as well as pinned specimens, would have been most welcome—but when is it not?

A few facts are missing in spite of the great depth of research (*Erebia magdalena's* early stages are no longer unknown, for example) and the bibliography is somewhat capricious, missing out some fundamental papers. That and other supportive back matter is generally helpful, however. A section on genitalic dissection with sample drawings will be extremely welcome to advanced amateurs. The glossary, checklist, index, host plant index and Ray Stanford's valuable maps for all species (county dots, extending slightly beyond the range of the book itself) complete the offerings. And although he doesn't get the last word, F. M. Brown's introductory section on early butterfly collectors in the Rockies must surely be the most engaging prose in the book. Brownie's extensive investigations into the history of Western butterfly exploration gives us all a fascinating framework in which to set our current knowledge, and the publishers were wise to include this summary.

I for one am willing to overlook the fact that the attractive cover bears a butterfly hardly emblematic of the Rockies, the California Sister. *Butterflies of the Rocky Mountain States* was worth the wait. Those who don't yet know this engaging fauna have a fine tool with which to begin; those of us who do will get to know it better thanks to Cliff Ferris, F. M. Brown and their coauthors. This is an excellent book by an authoritative team. They will get rid of its "bugs" in future editions. North American butterfly studies, understanding and conservation will all certainly benefit from its appearance.

A Field Guide to the Butterflies of the Pacific Northwest. **James R. Christensen (1981). The University Press of Idaho. 116 pp., 48 color plates, eight halftones, 14 figures. No price given, paperback.**

A very different attempt at a regional butterfly book, this is a member of the University of Idaho's "Northwest Naturalist Books" series. As a Northwest lepidopterist myself, I warmly welcome any worthwhile treatment of the region's butterflies. This modest book brings them all together for the first time, and it will prove useful for that alone. Its color photographs and field observations enhance the book's appeal and value both to the general naturalist and the butterfly enthusiast. Although it came as a complete surprise, unannounced until publication, Northwest naturalists were glad to see it.

Unfortunately the book is flawed in several respects, such that I can only recommend it with reservations. Sadly, many of the errors could easily have been avoided had the author sought wider consultation and more rigorous editing. Few lepidopterists active in the region concerned were contacted, so most of the text is based on limited second-hand information and geographically restricted field experience on the author's part. He knows the Yakima vicinity, but clearly has no concept of the coastal fauna, or that of the Olympics. Several very knowledgeable persons in the Northwest are not acknowledged in the book so they cannot have been asked for their input. My book *Watching Washington Butterlies* was relied upon and graciously acknowledged, but I was never contacted personally: therefore Mr. Christensen repeated several errors from my 1974 book. Our knowledge of the region and its butterflies has come a long way since then, but the present volume in no way reflects that growth. Hence it is partly obsolete upon publication. A fuller review is in press elsewhere, so I will not dwell in details here. One notices poor editing coming through in misspellings, incorrect constructions and a few nonsense sentences. Worse than this, misinformation abounds. The literature can have been searched only cursorily. Nonetheless the book has an enthusiasm and love of butterflies about it, and some excellent features, and these are not to be gainsaid by recognizing its faults.

Introductory material is brief and elementary, but helpful to beginners. A thoughtful section on distribution could use more examples, and neglects recent information (cf. Pyle, *Atala 8*:1). The author aligns butterflies too closely with the old physiographic provinces, a crude concept that fails to recognize their ecogeographic indicating powers. Generalizations are broad and not always supported. Very welcome however is a habitat and flower preference section, and indeed the attention given throughout the book to nectaring behavior is to be warmly applauded—most books neglect this important information. Species accounts, written in plain prose instead of sections, read easily but tend toward disproportionate emphasis: the Mourning Cloak (*Nymphalis antiopa*) and Milbert's Tortoiseshell (*N. milberti*) get five lines each, whereas three species of *Euphydryas* receive 83. Except among checkerspots and fritillaries, where lengthy discussion of subspecies prevails, nomenclature is elementary. Size, descriptions, references and distributions are all vague in the extreme, with exceptions. Many species said to occur "throughout the Northwest" do nothing of the kind. Rarities are given county designations, but there is no map, and species with equally intriguing ranges are glossed over inaccurately and to their injustice. Once again, a little help from his friends would have enhanced the accounts immeasureably.

On conservation, Mr. Christensen begins well and then stumbles. Apart from the obligatory mention of the historic Moxee Bog preserve of TNC, he devotes three well stated sentences to the matter of negative human impacts on butterflies. So far, so good. But then he characterizes clear-cut logging as having benefitted many species of butterflies in the Northwest. This is poppycock. I have sampled clearcuts extensively in Western Washington. A few highly opportunistic butterflies

expand temporarily into clearcuts; but between herbicides and erosion, clearcuts on the whole are butterfly deserts. The author's claim that clear-cut logging has enabled species adapted to high mountain meadows to expand their ranges is fatuous; nor does he address old-growth forest specialists that cannot tolerate the monocultures of dense, even-aged Douglas-fir and hemlock which follow clearcutting. Going from bad to worse, the author then enthuses about having chased parnassians across open habitat in a jeep: an appalling admission, in view of the great damage done to mountain meadows by errant off-road vehicles. Yet Mr. Christensen claims this was one of his most memorable days afield!

Such bravado aside, the book has its more sensitive side. This shows in the author's drawings and photographs. Far and away, the illustrations are the book's best feature. By combining pen-and-ink drawings, color photographs of pinned specimens and more color plates of butterflies in the field, this book gives users a real recognition advantage over those employing just one kind of illustration or another. Even here enthusiasm must be tempered, because the plates of spread specimens are poorly carried out and the field photos show dead or stunned butterflies. In the former, over-generous spacing, muddy backgrounds of awful colors and lots of shadow combine with variable focus and el cheapo printing to produce fairly forgettable results. Some of the images are so tiny and blurry as to be worthless, others are better. Printing resolution and color fidelity vary, tending toward bad. With such excellent color printing available today, one asks, why bother if the end product is no better than this? Some of the problem is judgment: tan skippers cryptic against a tan background, spaced such that they occupy just a third of the space.

The field photographs are much better in reproduction, on the whole; one wonders why? They range from quite superb (*Colias alexandrae, Anthocharis sara, Coenonympha haydeni*) to mediocre. Generally the color work on these is very satisfying. It would be more so if the legs, antennae and wing positions of most of the butterflies pictured were not so obviously indicative of manipulation. Unnatural postures and faked substrates do not lie. If the gassed nature of most of the subjects is immediately obvious, at least the author nowhere maintains that they are alive or natural. His pen and ink drawings depict typical caterpillars and chrysalids (no eggs, sadly) for each family. These are simple, very nice indeed and effective.

Butterflies of the Pacific Northwest will probably enable the buyer to identify most of the species of butterflies they encounter in the region. Inasmuch as that is its objective, it succeeds. On the grounds of accuracy and quality, it can be much improved and one hopes the opportunity will be taken to do so in future editions. The author is to be congratulated on a useful little book and urged to re-examine his sanguine attitudes toward clearcut logging and offroad jeeping as they relate to butterflies. He is also invited to consult his Northwest colleagues more fully in the future, to the certain betterment of his efforts. It would be churlish to compare his book to the Ferris-Brown Rocky Mountain volume; it bears no such pretensions. A more definitive treatment of the interesting Pacific Northwest butterfly fauna will be a team project for the future.

ROBERT MICHAEL PYLE, Swede Park, Loop Road, Box 123, Gray's River, WA 98621, USA

Atala Abstracts

Resuming its former title, this section continues to furnish abstracts of literature pertaining to invertebrate conservation. As well as recently published papers, ATALA ABSTRACTS pays attention to articles and books of an earlier vintage which have previously been overlooked. The categories established in ATALA 7(1) have been foregone in favor of a plain alphabetical listing, since many papers seem to overlap two or more of the categories. The editor welcomes submissions of reprints, photocopies and annotated references for inclusion in ATALA ABSTRACTS. Our intention is to publish an inclusive bibliography on the subject as supplement to a future number of the journal, superseding the first attempt at such a reference list in ATALA 2(1). The editor will attempt to fulfill requests for photocopies of shorter papers listed here, at cost ($0.10 per page plus postage). Please write to ascertain availability before sending money.

Anon. 1982. *The Conservation of Butterflies.* Nature Conservancy Council (UK), 26 pp. Written by Alan Stubbs (though not so acknowledged), this useful booklet joins three others in the NCC series covering other groups of invertebrates. Major headings are Conservation value, The life of a butterfly, Relationship to other animals, Vulnerability of butterflies (including recent extinctions and species declines in the U.K.), Conservation management and habitat requirements, Recording and studying butterflies, and useful addresses and references. Fifteen color photographs, a number of halftones and several graphs illustrates the booklet. See elsewhere in this issue for details on obtaining NCC booklets.

Bagdonas, K. R. 1981. Project 1793: Life history and ecology of rediscovered prairie sphinx moth, U. S. *World Wildlife Fund Yearbook 1981.* WWF, Gland, Switz. p. 145. The author reports on progress of a WWF - US project for which he is principal investigator. After its discovery in 1934, the moth was not seen until its rediscovery in northeastern Colorado in 1979. From an estimated population of 200-300 individuals in 1979, only 40-50 *Euproserpinus wiesti* were seen in 1980; the same year heavy mortality occurred from grasshopper spraying. Assuming a small population survived, ecological studies were to resume in 1981 in order to develop management measures for protection of the species.

Calvert, W. H. 1981. Project 1958: Conservation of Mexican Monarch butterfly. *World Wildlife Fund Yearbook 1981.* WWF, Gland, Switz. p. 142. The author reports on progress of a WWF - US project (highest priority of IUCN's Lepidoptera Specialist Group) for which he is principal investigator. The monarch butterfly (*Danaus plexippus*) overwinters in immense numbers in parts of California and Mexico. The Mexican sites are in jeopardy from logging and tourism. The current research has demonstrated that even selective logging, by opening the forest canopy, increases solar radiation gain during daylight hours and long-wave radiation loss during cooling periods. This is likely to lead to much higher mortality among overwintering monarchs during cool, wet weather. A decree by President Lopez Portillo of Mexico in 1980 formally protects the monarch, but management and habitat reservation measures are necessary to realize its intent. Understanding the effects of logging will be important in making and supporting forest protection proposals. Alternative income sources for local people will be necessary if lumbering revenues are diminished by conservation measures.

Carwardine, M. 1981. Butterflies cannot fight alone. World Wildlife News (WWF - UK) Autumn (81), p. 12-14. Briefly reviews the butterfly conservation situation in Britain. Butterfly Year 81-82 is introduced, and contributions solicited. Legislation, monitoring schemes and research activity are all important in reaching Butterfly Year's goals. The example of the heath fritillary (*Mellicta athalia*) is discussed.

Davis, B. N. K. (Ed.) 1981. *Ecology of Quarries*: the importance of natural vegetation. Inst. Terrestrial Ecol. (UK). 77 pp. The proceedings of a workshop held at Monks Wood Experimental Station, this volume contains eleven papers, an introduction and discussion sections. The three main subject areas covered are State and status, Natural processes, and restoration ecology. Some attention to invertebrate values of mineral-worked habitats is shown, including the example of Wingate Quarry in Durham; this was a rich botanical site and the haunt of the Durham argus butterfly (*Aricia artaxerxes*) until filled with refuse. The advanced state of knowledge in reclaiming quarried sites for conservation values in Britain should be widely applicable elsewhere.

Eaton, P. and P. Sinclair (Eds.) 1981. The Papua New Guinea environment, 1981. *Wildlife in Papua New Guinea* 81/12 (87 pp.). Written in very accessible English by a number of contributors, this helpful summary groups articles under the headings of Wildlife, Resource Management, Forests, People and Land, Pollution, Legislation and Conclusion. Invertebrate sections are "Conserving the world's largest butterfly" and "Insect Farming and Trading Agency in Papua New Guinea," by Mike Parsons; and "The shell trade in Papua New Guinea" by Susan Wells. The articles originally appeared in a column entitled "Environment" in *The Times* (Port Moresby) during 1981. The byline for that column was "Conservationist," so the pieces are not individually credited. The booklet can be requested from the Division of Wildlife,

Department of Lands and Environment, P. O. Box 2585, Konedobu, Papua New Guinea.

Ebert, G. and G. Schmid (Eds.) Biotop- und Artenschutz bei Schmetterlingen (Conservation of Lepidoptera and their habitats). *Beih. Veroff. Naturschutz Landschaftspflege Bad.-Wurtt. 21*: 1-232. (Karlsruhe). These are the proceedings of the Second European Congress of Lepidopterology, held in Karlsruhe, West Germany in 1980. Since the major theme of the Congress was conservation, this softbound volume constitutes a major resource on the subject of butterfly and moth conservation. There are, in addition to a foreword, and afterword and four appendices, twenty-two papers covering a wide range of subjects to do with the title of the volume. These range from reports on conservation of Lepidoptera in various countries and habitats to the use of Lepidoptera as environmental indicators and research in management techniques. Numerous photographs and figures in color and halftone accompany the papers, which appear either in German or English with a summary in the other (one French paper has English and German summaries). Abstracts will appear in ATALA as reprints are received.

Ebert, G. 1981. Flattern bald die letzten Falter? *Umschau in Wissenschaft und Technik* No. 4, 15 February. The expansion of cultivated areas in West Germany is destroying the habitats of many butterflies and moths. Half of all the species are facing extinction. Laws to protect endangered species cannot counter this threat alone. Furthermore, the draft federal regulations for the protection of endangered species appear quite incomplete, and without any scientific basis in large part. (In German.)

Ebert, G. 1981. Mussen Schmetterlinge aussterben? *Beih. Veroff. Naturschutz Landschaftspflege Bad.-Wurtt. 21*: 7-13. In the opening address to the Second European Congress of Lepdiopterology, the author asks whether butterflies and moths must become extinct. A number of examples of Lepidoptera at risk in West Germany are given, along with circumstances governing their survival. (In German, no English summary.)

Ebert, G. 1981. Die Kartierung biologish-ökologisch wertvoller Biotope in Baden-Wurttemberg—ein neuer Impuls zur landesfaunistischen Forschung. *Beih. Veröff. Naturschutz Landschaftspflege Bad.-Wurtt. 21*: 151-164. Survey of habitats of biological and ecological value and its utility for a faunistic inventory of the Macrolepidoptera of Baden-Wurttemberg. By means of so-called "Erhebungsbogen" (survey cards), a survey of habitats of biological and ecological value was carried out by order of the Ministry of Food, Agriculture and Environment. The survey is explained and the importance of a faunistic inventory of the Lepidoptera is pointed out. On the basis of such a survey, qualified statements may be made about 1) the topographically correct situation of a locality; 2) character of the habitat, as catalogued by a check-list; 3) threatened species; 4) which species may be used as indicators, by appropriate correlation of information on species and habitats; and 5) the possibility to figure more precisely than usual the localities and distribution areas of species through mapping schemes based on 1:25,000 topographic maps. Because of its advantages, this kind of survey (Biotopkartierung) and its methods were integrated into the ongoing program of faunistic inventory of the Macrolepidoptera of Baden-Wurttemberg, West Germany. (In German with English summary, as above. 14 color plates; maps and figures.)

Kitchen, M. 1982. (Now the axe has fallen) Is our wildlife doomed? *The Times* (Port Moresby), 12 March, pp. 14-15. Severe financial cutbacks have recently been applied to the Office of Environment and Conservation, particularly the Division of Wildlife, in Papua New Guinea. The PNG wildlife program has been considered an enlightened model for tropical developing nations, but the cuts make it questionable whether PNG will be able to maintain its own wildlife. On the whole, profit-making projects have been retained while those with longer-term projects have been discarded or crippled by cuts. The Insect Farming and Trading Agency has been transferred to the Department of Primary Industry and told it must become more profitable quickly. Protection efforts on behalf of Queen Alexandra's birdwing butterfly and other endangered species may become impotent or absent altogether. The Constitution of Papua New Guinea guarantees that "All necessary steps to give adequate protection" to the nation's wildlife, specifically including insects, will be taken. These developements call into serious question the government's ability to do so.

Morris, M. G. 1981. Responses of grassland invertebrates to management by cutting. II. Adverse effects on Auchenorhyncha. *J. appl. Ecol. 18*: 107-123. The responses of Auchenorhyncha (leafhoppers) to management by cutting of calcareous, *Arrhenatherum*-dominated grassland were examined in a field experiment carried out over three years. Twenty-three species of leafhoppers reacted in different ways to the cutting regime. The most dramatic effects came from a July cut, which severely reduced numbers of most species. Interreaction of the timing of treatment with the phenology of leafhoppers explains many of the findings, and stratification of species in tall grass is seen to be an important factor in determining the fauna of grasslands. The findings support earlier recommendations for the management of grassland nature reserves, but the positive responses of other leafhoppers to cutting should also be taken into account. These are not reported here.

Nagano, C. D. 1981. California coastal insects: another vanishing community. *Terra 19*(4): 27-30. (Los Angeles Co. Museum of Nat. Hist.) The attractively illustrated article investigates

the present and future of a number of strand-community insects endemic to the California coast, as well as estuarine species. Coastal insects perform indispensable services yet they are little-recognized and seldom considered when actions are taken to change their habitats. Insects from several orders are discussed, including the extinct Xerces blue and Antioch shieldback cricket (extinct before it was discovered as being a new species) and the endangered Lange's metalmark and El Segundo blue. Many shore species, while not yet strictly endangered, are diminishing alarmingly; these include tiger beetles, wingless wasps and others. Marinas, filling and dredging, pollution and kelp removal all put insects at risk.

Opler, P. A. 1981. Management of prairie habitats for insect conservation. *J. natural Areas Assoc. 1*(4): 3-6. The author maintains that prairie invertebrates are usually neglected in conservation efforts, as management efforts are oriented toward vertebrates and plants. A number of instances of jeopardized insects on North American prairies are discussed (*Lethe fumosa*), the Dakota skipper (*Hesperia dacotae*) and *Flexamia rubranura*, a large and beautiful Illinois leafhopper that may already be extinct. Three principles or processes are considered important to management and conservation of prairie insects—survey and monitoring, individually, with examples. Size of reserves and distances and corridors between them are considered to be vital factors for rare prairie insect species' survival.

Owen, D. F. and W. R. Whiteway. 1980. *Buddleia davidii* in Britain: history and development of an associated fauna. *Biol. Conserv. 17*: 149-155. The well-known nectar plant called butterfly bush (*B. davidii*) was introduced to Britain in the 1890's and began to colonize waste land and building sites in the 1930's. It now occurs in almost every town, especially on calcium-rich soil to which it is highly tolerant. No other plant produces flowers so attractive to butterflies and other insects for their nectar. Eleven species of Lepidoptera in Britain are known to utilize the leaves or flowers of butterfly bush as larval hosts. The shrub is in every sense considered by the authors to be a useful introduction, exploiting a previously empty niche. Its development of an associated fauna as well as its great nectar attractiveness make it a welcome member of the British flora despite not being indigenous.

Pyle, R., M. Bentzien and P. Opler. 1981. Insect conservation. *Ann. Rev. Entomol. 26*: 233-258. The paper comprehensively reviews the field of insect conservation. Under "Rationale and needs" it discusses modern extinctions, local population losses and value of insect resources. "Causes of arthropod decline" considers urbanization, acid rain, electric lights, water impoundment, stream pollution, wetland draining, agricultural conversion, off-road vehicles, loss of host, exotic introductions, overcollecting and pesticides as factors potentially involved. Habitat alteration is put forth as by far the most important risk to insects. The authors discuss the history of insect conservation, including legislative efforts, management measures and political actions. Includes a substantial but selective list of references.

Pyle, R. M. 1981. The role of IUCN and WWF in Lepidoptera conservation. *Beih. Veroff. Naturschutz Landscahftspflege Bad.-Wurtt. 21*: 15-18. The International Union for Conservation of Nature and Natural Resources exists to conserve biological diversity on an international scale. Endangered species conservation is the province of IUCN's Species Survival Commission. One of SSC's Specialist Groups deals specifically with Lepidoptera. In 1979, IUCN initiated an Invertebrate Red Data Book, parallel to its well established RDBs for vertebrates, which will give much attention to Lepidoptera. Through the advice of the Lepidoptera Specialist Group and acting on priorities identified in the Red Data Book, World Wildlife can allocate funds for Lepidoptera conservation projects around the world. (NB. See above references for Bagdonas, Calvert and Kim.)

Roesler, R. U. and W. Speidel. 1979. Rote Liste der in Baden-Wurttemberg gefahrdeten Zunslerfalter (Pyraloidea). *Veroff. Naturschutz Landschaftspflege Bad.-Wurtt. 49/50*: 371-395. This is probably the first paper devoted to rare or threatened species of Microlepidoptera and their conservation. The authors discuss the taxonomy of pyraloid moths, and the grounds for classifying them under different degrees of threat. The actual red data list of the state's pyraloids categorizes 109 species under seven risk headings ranging from likely extinct to potentially threatened. Thirteen species, or 6.37% of the state's fauna, are considered extinct or lost; 34 species (16.67%) are in danger of extinction; 30 species (14.71%) are seriously threatened, 17 species (8.33%) threatened and 9 species (4.41%) potentially threatened. Five species are threatened as resident breeders, and one as a migrant visitor. These data are correlated with habitat and vegetation types and changes. (In German.)

Schindler, P. (Ed.) 1977. Apropos insekten (A propos d'insectes). *Schweizer Naturschutz (Protection de la Nature) 43*(4): 2-18. Much of this issue of the Swiss nature protection journal is devoted to consideration of insects, in German and French. Articles consider the status of dragonflies, butterflies and moths, beetles, wood ants, biological control, grasslands and other topics. Written at a popular level and well illustrated. The butterflies protected in three Swiss cantons are listed.

Tassi, F. 1969. Problemi di conservazione nel campo dell'entomologia. *Estr. Dalle Mem. Soc. Entomol. Ital. 48*: 609-626. The author examines the problems of insect conservation and discusses the function of insects in ecosystems. The main causes of extinction are emphasized and examples of threatened insects from several European countries given. These include the saturnine moth *Brahmaea*

europaea and the carabid beetles *Carabus olympiae*, both pictured in color photographs. (In Italian.)

Tassi, F. 1972. Gli insetti nella protezione della natura. *Atti del IX Congresso Nazionale Ital. di Entomol.*, pp. 3-17 + 5 pl. Insect conservation is discussed with special reference to the English experience in the field. Adequate protection measures are proposed. Examples of threatened European insects which are both discussed and depicted in the plates include the earwig *Forficula appenina*, the bupestrid beetle *Acmaeodera tassii* and three other beetles. (In Italian.)

Young, Geffrey. 1981. How to save butterflies. *Natural World* 2 (Autumn 1981): 30-31 & 42. (RSNC, Lincoln). Another article presenting Butterfly Year 81-82 in the United Kingdom. Several rare British butterflies are pictured and discussed in brief. The author argues that common species are just as interesting and complex as rarities and they deserve attention as well. Butterfly Countdown, a project of WATCH (a children's activity program of which the author is Creative Director) is introduced. (NB. The results of the Butterfly Countdown will be summarized in a later issue.)

EDITORIAL STAFF OF *ATALA*

Robert Michael Pyle
Editor
Swede Park
Loop Road, Box 123
Gray's River, WA 98621
USA

Lorraine L. Rothman
Managing Editor
The Lepidoptera Research Foundation, Inc.
c/o 128 South Kings Road
Los Angeles, CA 90048
USA

SUGGESTIONS FOR CONTRIBUTORS

Formal scientific articles and notes dealing with any aspect of the ecology and conservation of invertebrates and their habitats are solicited. Articles will generally be longer papers, notes not exceeding 1000 words. Reviews of books dealing with terrestrial arthropod conservation or endangered habitats are also invited. Appropriate philosophical papers will be welcomed for use in the "Commentary" section.

All manuscripts should be typewritten on white, 8½ x 11 inch, good quality bond paper, on one side only, double- or triple-spaced throughout, with margins of at least one inch on all sides. The original typescript and at least one (preferably two) xeroxed or carbon copies should be submitted; authors should also retain a copy of manuscripts and figures for later consultation with the editors.

Please include illustrations if appropriate. Figures should be consecutively numbered in Arabic numerals. Hand-drawn figures should be rendered in black ink on good quality white paper. They may be larger than final reproduced size. Black and white glossy photographs may also be submitted. These and artwork will be returned after publication if accompanied by return postage. Figure captions should be typed, double-spaced, on a separate sheet, and the number of the figure lightly pencilled on the back of each drawing or photograph. A sketch map should be included as a figure with all articles or notes dealing in a major way with a specific region or arthropod habitat.

Cover art changes with each issue, and contributions will be gratefully received. Cover illustrations should generally show insects or other arthropods in natural settings, and prospective cover artists should consult with the Editor before submitting material.

Tables should be numbered consecutively in Arabic numerals and submitted in camera-ready condition on separate sheets. Please include full scientific name, *with authors*, for both plants and animals mentioned in any manuscript submitted for publication in *Atala*. The metric measurement system should normally be used, with English system equivalents in parentheses if desired. Full references to literature cited should appear in a separate section at the end of articles or commentary papers, but parenthetically incorporated within the text of notes. Please include an *informative abstract* of approximately 150 to 250 words with all articles. Avoid footnotes to text statements if possible; such information can usually be included within the text. Words to be set in *italics* (including scientific names) should be underlined. Reprints of articles are available at cost. An author will receive a reprint order form after acceptance of a manuscript. The style of *Atala* generally follows that recommended in the *CBE Style Manual* (1972). Abbreviations of journal titles follow *Bibliographic Guide for Editors and Authors* (1974).

COVER

Tiger beetles of the genus Cicindela (Coleoptera: Cicindelidae) are territorial predators that range throughout North America. A number of species are restricted to marine littoral ecosystems such as salt marshes, sand dunes and open beaches. Some coastal California Cicindela are threatened with extinction because of habitat destruction caused by harbor construction, urban development and increased recreational beach use. See article by Christopher D. Nagano in this issue.

The cover artist is Robin Jarrett of the Los Angeles area. Robin has previously drawn for the cover of *The Journal of Research on the Lepidoptera.*

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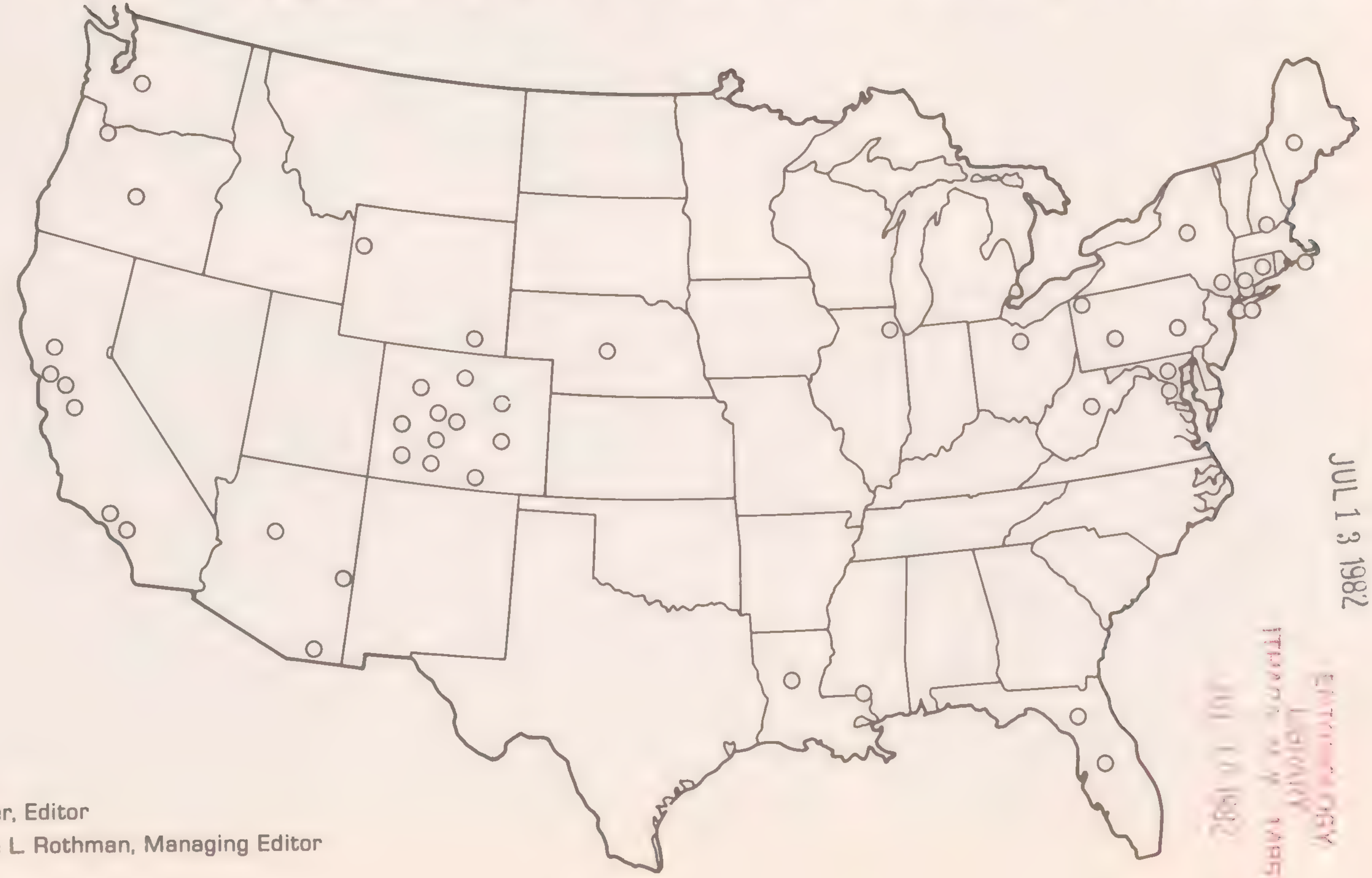
1980 BUTTERFLY COUNT RESULTS



Ira Heller, Editor
Lorraine L. Rothman, Managing Editor

FOURTH OF JULY BUTTERFLY COUNT 1980 RESULTS

1980 FOURTH OF JULY BUTTERFLY COUNT

edited by Ira M. Heller

The Fourth of July Butterfly Count for 1980 covered the period from 21 June to 13 July. There were 50 counts reported, involving 363 participants distributed among 19 states. Colorado and Connecticut were best represented with 11 and 5 counts respectively.

Numbers of species observed ranged from 4 (UCLA campus, CA), to 62 (Springerville, AZ) to 86 (Gilpin Co., CO, Lower Circle) and averaged 29.3 species per center. Numbers of participants ranged from 1 (7 counts) to 65 (Clatter Valley, New Milford, CT) and averaged 7.3 participants per count. In excess of 33512 butterflies were observed nationwide (an average of 670.3 specimens per count). 50 counts were conducted this year. 42 (84%) represent continued coverage of a count zone while 8 counts (16%) were reported for new sites.

ZONE 1: SOUTHWEST
(Arizona, California)

Atascosa Highlands, AZ. 31°27'N, 111°11'W, center nr. Corral Nueva, NW side of Atascosa Mts., includes Pena Blanca Lk., Arivaca Lk., Atascosa Lookout, Sycamore Cyn. Elev: 1200 to 2078 m. Habitat coverage: Thorn-scrub cyns., pinyon-oak woodlands, riparian vegetation (willows, sycamores, etc.) 19 July 1980; 0800-1800 hrs.; A.M. mostly cloudy to mostly clear in P.M.; 15.5-35°C.; winds negligible. Eight observers in four parties. Total party hours 26 (25 on foot, 1 by car); total party miles 20 (all on foot). Observers: Richard Bailowitz (1750-B Xavier Way, Nogales, AZ), Jeff Burn, Doug Danforth, Natalie Danforth, Doug Mullins, Mary Mullins, Steve Prchal, Floyd Werner. Conservation status of land: Almost all Nat. Forest (Coronado). Uniqueness of habitats: Drains into Mex. Imminent threats, changes since last year: None. Danaus gilippus 15(S), Euptychia rubricata 6(S), Asterocampa montis 5(S), A. subpallida 1(N), A. leila 37(S), Adelpha bredowii 1(S), Limenitis astyanax 10(N), L. archippus 7(N), Texola elada 85(N), Dymasia chara 63 (N), Vanessa virginiensis 1(S), Agraulis vanillae 3(S), Celephelis nemesis 1(S), C. arizonensis 29(N), Apodemia mormo 2(N), Ministrymon leda 2(S), Strymon melinus 3(S), Brephidium exilis 3(S), Leptotes marina 93(S), Hemiargus isola 1(S), H. ceraunus 19(S), Everes comyntas 15(N), Colias cesonia 5(S), Phoebis sennae 1(S), Eurema nicippe 10(S), Nathalis iole 2(S), E. mexicana 29(S), Battus philenor 92(S), Papilio multicaudata 4(S), Amblyscirtes aenus 9(N), Yvretta carus 2(N), Copaeodes aurantiaca 20(S), Celotes nessus 5(S), Pyrgus philetas 2(N), P. communis 1(N), Erynnis tristis 1(N), Systasea zampa 7(S), Staphylus ceos 19(N), Cogia hippalus 41(N), Thorybes pylades 1(N), Achalarus casica 1(N), Codatractus arizonensis 5(S). Total 42 spp., about 659 individuals. Larvae seen: Battus philenor 20(on Aristolochis sp.). Field notes: Rains have been spotty of late, grasses and flowers are sparse. Attractants are far and few between except for Cnidoscolus and Kidneywood. No southern influx yet. Small amounts of water in the streams.

Springerville, AZ. 34°05'N, 109°19'W, center 5 mi SW Springerville, includes Springerville, South Fork, Mexican Hay Lk, Walter Cyn., etc. Elev: 2240-2857 m. Habitat coverage: Ponderosa pine, pinyon-juniper, upland grassland, cienega. 15 July 1980; 0800-1700 hrs., Clear in A.M. to partly cloudy in P.M.; 12.8-32.2°C.; wind nil. Two observers in one party. Total party hours 9 (1.5 on foot, 7.5 by car); total party miles 50 (2 on foot, 48 by car). Observers: Richard Bailowitz, Douglas Danforth. Conservation status, land uses: Mostly in Apache National Forest. Imminent threats, changes since last year: None. Danaus plexippus 30(S), D. gilippus 15(S), Cercyonis oetus 80(N), Coenonympha ochracea 30(S), Adelpha bredowii 3(S), Limenitis weidemeyeri 8(S), Phyciodes campestris 3(S), Thescalia fulvia 5(S), Poladryas arachne 26(S), Euphydryas anicia magdalena 12(N), Polygonia satyrus 14(S), P. zephyrus 3(N), Vanessa atalanta 1(S), V. cardui 22(S), V. virginiensis 10(S), V. annabella 30(S), Nymphalis milberti 6(N), N. antiopa 10(S), Euptoieta claudia 49(S), Speyeria electa nausicaa 15(S), Apodemia nais 2(N), Hypaurotis crysalus 1(S), Callophrys spinetorum 1(S), C. siva 5 (S), C. apama 5(N), Ministrymon leda 1(S), Atlides halesus 2(S), Strymon melinus 18(S), Lycaena rubidus 12(N), Brephidium exilis 1(S), Leptotes marina 10(S), Hemiargus isola 3 (S), Glaucopsyche lygdamus 50(N), Celestrina argiolus 3(S), Plebejus melissa 2(S), P. saepiolus 15(N), P. icariodes 50 (N), P. acmon 5(S), Colias eurytheme 24(S), C. cesonia 2(S), Nathalis iole 3(S), Neophasia menapia 40(N), Pieris protodice 45(S), P. rapae 1(S), Papilio bardii 2(S), P. multicaudatus 2(S), P. rutulus 4(S), Amblyscirtes simius 1(N), Poanes taxiles 3(S), Hesperia uncas 12(N), H. pahaska 7(N), Polites draco 2(N), P. themistocles 6(N), Oarisma garita 105(N), Piruna pirus 3(N), P. polingii 16(N), Pyrgus communis 3(N), Erynnis icelus 1(N), E. afranius 1(N), Thorybes pylades 15 (S), T. mexicana 6(S), Epargyreus clarus 6(S). Total 62 spp., about 866 individuals. Field notes: This count contains some of the best areas of blend zone of Rocky Mt. and Southern Arizona butterflies.

Ramsey Canyon, AZ. 26°10'N, 112°20'W, center 2.5 mi ESE Nicksvelle, AZ, includes eastern flank of Huachuca Mts. north to Brown Cyn., S to Coronado Nat'l. Monument, E to the San Pedro River, N to 2 mi S of Sierra Visa, AZ. Elev: 1250-2900 m. Habitat coverage: 60% mesquite/grassland, Acacia sp., Poa sp., 20% oak-juniper woodland, Quercus sp., 6% cottonwood forest, Populus sp., 10% mixed deciduous cyn., 4% cultivated fields, alfalfa. 13 July 1980; 0700-1600 hrs.; A.M. - mostly cloudy with intermittent rain, P.M.-mostly cloudy; 16-30°C.; winds nil. Fourteen observers in three parties. Total party hours 17 (13 on foot, 4 by car); total party miles 65 (7 on foot, 58 by car). Observers: Richard Bailowitz, Rick Bowers, Doug Danforth, John Epler, Wendy Hakes, Connie Hewett, Rick Hewett (RR 1, Box 84, Hereford, AZ 85615), Mary Ellen Knisely, Neal Krug, Linda Lamma, Arnie Morehouse, Leonard Taylor, Bee Torrey, James Wurzel. Conservation status of land, uses: Cattle ranching, crop production, firewood growing, U.S. Forest area, private homes and homesteads. Uniqueness of habitat: Three moist high elevation mountain cyns. within surrounding arid desert grass and mesquite lands; productive agricultural plots (esp. alfalfa) that attract unusual spp; coniferous forests in mountain area. Imminent threats: Development of subdivisions in low elevation areas; erosional runoff damage along creeks and drainage basins. Changes since last year: Continued construction of subdevelopments, esp. in mesquite/grassland area. Danaus plexippus 2(S), D. gilippus 70(S), Euptychia henshawi 15(N), E. rubricata 6(N), Adelpha bredowii 4(S), Limenitis astyanax 5(S), Phyciodes tharos 4(N), P. mylitta 2(S), Texola elada 4(S), Chlosyne lacinia 2(S), Vanessa cardui 5(S), V. virginiensis 13(S), V. annabella 2(N), Nymphalis antiopa 18(S), Emesis zela 3(S), Ministrymon leda 6(S), Strymon melinus 15(S), Brephidium exilis 2(N), Leptotes marina 1515(S), Hemiargus ceraunus 6 (N), H. isola 5(S), Celastrina argiolus 8(S), Plebejus acmon 2(S), Colias eurytheme 20(N), Eurema nicippe 30(N), E. mexicana 30(S), Nathalis iole 1(S), Pieris protodice 4(S), Battus philenor 32(S), Papilio multicaudatus 4(S), Amblyscirtes cassus 19(N), A. aenus 12(N), A. nysa 1(S), A. finbriata 13(S), Poanes taxilis 118(N), Copaeodes aurantiaca 4(S), Pyrgus communis 15(S), Erynnis juvenalis 3(N), E. tristis 9(N), E. funeralis 2(N), Staphylus ceos 3(S), Hylephila phyleus 3(S), Cogia hippaulus 3(N), Thorybes pylades 3(S), Autochton cellus 1(S), Zestusa durus 2(S), Epargyreus clarus 3(S). Total 47 spp., about 2100 indiv. Field notes: A very disappointing count. The previous night had brought rain, clouds and low temperatures. The count was postponed 2 hrs. until sunlight gave us enough hope to start. It was hit and miss all day.

Willow Slough, Yolo County, CA. $38^{o}34'$N, $121^{o}44'$W, center 2.6 km N of Slide Hill Park, Davis. Habitat coverage: see earlier reports. 4 July 1980; 1100-1500 hrs.; clear in A.M., P.M.; 23-28°C.; wind SSW, 3-10 km/hr. One observer in one party. Total party hours 4 (on foot); total party miles 8. Observer: A.M. Shapiro (Dept. of Zoology, Univ. of Calif., Davis, CA 95616), Conservation status, uniqueness of habitats and threats: See earlier reports. Changes since last year: Vegetation tallest ever, area was flooded for 8 weeks in winter, 0.38" unseasonable rain 2 July, creek still running, outbreak of grasshopper Melanoplus sp. in floodplain. Danaus plexippus 14(S), Limenitis lorquini 1(S), Precis coenia 12(S), Phyciodes campestris 16(S), P. mylitta 4(S), Vanessa atalanta 2(S), V. annabella 20(S), Satyrium sylvinus 1(N), Strymon melinus pudica 6(S), Lycaena xanthoides 24(S), L. helloides 20(S), Brephidium exilis 50(S), Plebejus acmon 15(S), Everes comyntas 7(S), Colias eurytheme 293(S), Pieris rapae 175(S), Papilio zelicaon 6(S), Lerodea eufala 3(S), Atalopedes campestris 3(S), Polites sabuleti 1(S), Pholisora catullus 2(S), Pyrgus scripta 4(S), P. communis 25(S), Erynnis tristis 2 (S). Total 24 spp., about 706 indiv. Larvae seen: P. zelicaon 4 (on Foeniculum vulgare), P. rapae 23 (on Lepidium latifolium), P. catullus 8 (on Amaranthus sp.), P. communis 2 (on Malva sp.), P. scripta 10 (on Sida hederacea). Field notes: Vanessa cardui and Pieris protodice completely absent from Yolo County this year to date. Season is extremely late. Note high numbers of L. xanthoides, usually almost gone by now, not abnormally abundant this year, just late. P. campestris 1st brood didn't fly until 4 May (3 or 4 wks late), 2nd only starting now. Alfalfa cutting completed about 12 days ago, most sulphurs in area are worn. This is the 4th straight year with a cool 4th of July.

UCLA campus, CA. $34^{o}04'$N, $118^{o}27'$W, center just SW of SW perimeter of UCLA campus. Elev: 110-150 m. Habitat coverage: 100% university campus. 13 July 1980; 1350-1710 hrs; mostly cloudy in AM, clear and hazy in PM; 24-25°C; winds WSW, 8-16 km/hr. One observer in one party. Total party hours 3.3 (on foot); total party miles 3. Observer: William C. Bakewell (10824 Lindbrook Dr., Apt 309, Los Angeles, CA 90024). Conservation status, uses of land: University campus. Uniqueness of Habitat: None. Imminent threats: None. Changes since last year: None. Nymphalis antiopa 1(S), Leptotes marina 3(S), Pieris rapae 1(S), Hylephila phyleus 1(S). Total 4 spp., about 6 indivduals.

Berkeley, CA. See 1975 report for count area description. 28 June 1980; 0740-1710 hrs; 18-33°C; winds W, NW, 0-20 km/hr. Sixteen observers in eight to ten parties. Total party hours 56.5 (50 on foot, 6.5 by car); total party miles 175.5 (52.5 on foot, 123 by car). Observers: Buegler, M., DeBenedictis, J., Frankie, G., Fraser, J., Fraser, M., Kelson, R., Langston, R., Meredith, S., Orsak, L., Powell, D., Powell, J. (201 Wellman Hall, U.C. Berkeley, CA 94720), Randal, E., Rude, P., Smith, K., Wagner, D., Washburn, J. Conservation status of area, uses of land, uniqueness of habitats, and imminent threats: See 1975 report. Changes since last year: Although party hours increased more than 100%, numbers of butterflies/hr decreased from 72 to 42. Totals for some spp. were lower: B. philenor 70-77% of 1979-78; C. eurytheme 77% of 1978; C. argiolus 42-48% of 1977-79; E. enoptes 37-43% of 1978-79; P. acmon 51% of 1979; L. xanthoides 83% of 1979; S. melinus 53% Of 1979; P. mylitta 57-87% of 1977-79; and P. satyrus and P. coenia only 40% of 1978-79. Danaus plexippus 8(S), Cercyonis pegala 59(S,C), Coenympha california 90(S), Adelpha bredowii 29(S), Limenitis lorquini 14(S), Precis coenia 96(S), Phyciodes campestris 2(C), P. mylitta 68(S,C), Chlosyne pella 1(C), C. leanira 2(C), Euphydryas chalcedona 293(S), Polygonia satyrus 8(S.C), Vanessa atalanta 11(S), V. cardui 2(S), V. virginiensis 7(S,N), V. annabella 27(S), Nymphalis antiopa 25(S), Speyeria coronis 6(C), S. callippe 2(C), Agraulis vanillae 21(S), Habrodais grunus 25(S,C), Satyrium sylvinus 10(S,C), Callophrys augustinus 2(C), Strymon melinus 10(S,N), Lycaena arota 4(S,C), L. gorgon 15(S,C), L. xanthoides 39(S,N,C), L. helloides 7(C), Brephidium exilis 1(C), Philotes enoptes 15(S,C), Celastrina argiolus 28(S,N), Plebejus acmon 74(S,N), Colias eurytheme 40(S), Pieris napi 2(S,C), P. rapae 430(S,N), Anthocaris sara 2(C), Euchloe ausonides 36(S,C), Battus philenor 24 (S), Papilio zelicaon 48 (S), P. rutulus 54(S), P. eurymedon 33(S), Lerodea eufala 2 (C), Ochlodes sylvanoides 1(C), O. agricola 91(S,C), Polites sabuleti 30(S,N), Hylephila phyleus 61(S), Pyrgus communis 113(S), Erynnis tristis 32(S,C). Total 48 spp., about 2133 indiv. Larvae seen: P. zelicaon 1 (on Foeniculum vulgare), B. philenor 10 (on Aristolochia californica). Field Notes: Substantial increase in party hours resulted in the highest numbers of species and indiv. recorded for the Berkeley count in six years, but the number of individuals/party hour dropped dramatically, from 72 in 1979 to 42.6. Three urban parties averaged 34.6 sp./ hr in counting 22, 20 and 18 spp., while 5 country parties averaged 49.6 sp./hr, logging 32, 31, 31, 30 and 23 spp. El Sobrante, with 22 spp., showed the highest count at a single locality. Jewel Lk., Russell Tree Farm and Redwood Cyn. all had 21 each. Three spp. previously listed only as potentials were taken: L. eufala (Berkeley landfill), L. helloides and B. exilis (3 mi NE Dam Rd. in Pinole Valley), bringing the total observed in six years to 58 species.

Mt. Diablo, CA. $37^{o}57'$N, $121^{o}52'$W, center 1 km SW Nortonville includes San Joaquim River W of Pittsburg to E of Antioch, Browns, Winter and Kimball Islands; Antioch Dunes Wildlife Reserve; Nortonville Hills; Clayton Valley; part of Marsh Cr.; Mt. Diablo S to North Gate Rd. Elev: 4-1177 m. Habitat coverage: Salix-Umbellularia-Quercus riparian cyn. at 120 m; Adenostoma chaparral to Juniper-Quercus woods at 870 m (8 July). Riverine sand dune remnants, with Quercus-Salix riparian edge (13 July). 8 July 1980; 1030-1730 hrs; AM - partly cloudy, PM - mostly clear; 18-25°C; wind W, NW, 10-40 km/hr. Two observers in one party. Total party hours 7 (on foot); total party miles 10.5. Observers: Powell, D., Powell, J. (201 Wellman Hall, UC Berkeley, CA 94720), Orsak, L. Conservation status: Antioch Dunes area purchased in 1980 as a wildlife preserve; Mt. Diablo St. Pk.; Black Diamond Mines Regional Preserve and Contra Loma Regional Park. Uniqueness of habitats: Antioch Dunes had 26 insects described as type locality prior to extensive decimation by industrialization and sand mining. Mt. Diablo and Nortonville Hills mark the northern limits of a number of coast range floral elements. Changes since last year: First year count. Danaus plexippus 3(larvae), Cercyonis sthenele 63(S,C), Coenonympha californica 16(S), Adelpha bredowi 8(S), Limenitis lorquini 1(N), Phyciodes mylitta 8(S,N), Euphydryas chalcedona 34(S), Polygonia satyrus 1(pupa), Vanessa annabella 2(S), Speyeria callippe 17(S,N), Habrodais grunus 34(S,N), Satyrium saepium 23 (S,C), S. tetra 6(S,C), S. sylvinus 1(C), Lycaena arota 1(C), L. gorgon 11(S,N), Celastrina argiolus 6(S), Plebejus acmon 17(S,N), Colias eurytheme 4(S), Pieris rapae 28(S), Papilio rutulus 1(N), P. multicaudatus 3(S,N), P. eurymedon 2(S), Ochlodes agricola 50(S,N), Helioptes erecetorum 2(S), Erynnis tristis 3(S). Total 26 spp., about 353 indiv. Also observed during count week but not on count day: Precis coenia 3(S), Nymphalis antiopa 1(S), Strymon melinus 6(S), Brephidium exilis 11(S), Everes comyntas 5(S), Atalopedes campestris 2(S), Hylephila phyleus 1(S), Pyrgus communis 2(S). Larvae seen: E. chalcedona 100+ (on Mimulus aurantiaca), D. plexippus 3 (On Asclepias californica). Field notes: The day selected turned out to be unseasonably cloudy and cool; it was later in the season than optimal, judging from condition of specimens and lack of late spring species. An additional survey of the Antioch Dunes Wildlife Preserve was made during count week but not on count day by L. Orsak on 13 July. One party on foot, 3.5 hours; 12 spp., about 80 indiv. including 8 spp. not seen on count day (they are enumerated above).

San Joaquim Co., CA. $30^{o}13'$N, $121^{o}17'$W, center Woodbridge Post Office, includes Lodi, Woodbridge, Acampo, Victor, Oak Grove Park. Elev: 0-5 m. Habitat coverage: Broad dry creek bottom, some mud puddles with water. (This is site #4 in 1978 count, not visited in 1979). 24 July 1980; 1000-1500 hrs; clear all day; 27-38°C; wind NE, 0-10 km/hr. Two observers in one party. Total party hours 4 (all on foot); total party miles not cited. Observers: Kirby Brown (P.O. Box 1809, Stockton, CA 95201), Rebeccah Hanson. Conservation status, uses of land: Unused natural habitat. Uniqueness of habitat: Typical seasonal creek bed, but very broad and thickly vegetated. Imminent threats: None. Changes since last year: Stone wall built to prevent access to vehicles. Veg. very lush due to heavy winter rains. Danaus plexippus 1(S), Limenitis lorquini 2(S), Precis coenia 1(C), Phyciodes mylitta 1(C), Vanessa atalanta 1(S), V. annabella 2(S), Nymphalis antiopa 2(C), Satyrium sylvinus 3(C), Lycaena helloides 1(C), Brephidium exilis 1(S), Colias eurytheme 1(S), Pieris rapae 300+(S), Papilio rutulus 3(C), Pholisora catullus 10 (S). Total 14 spp., about 329 indiv. Larvae seen: Papilio zelicaon 1 (on Anise).

Santa Monica Mts., CA. 34°05'N, 118°42'W, center Tapia Co. Park (L.A. Co.), includes Newton Cyn. (west), Malibu Salt Marsh (south), Cold Cr. Cyn. Preserve (east), Ladyface Park (north), Tapia Co. Park and Malibu Cr. St. Park. Elev: 0.8-77 m. Habitat coverage: 37% streamside, 24% grassland, 17% oak woodland, 14% coastal sage scrub, 6% chaparral, 2% salt marsh. 12 July 1980; 0900-1500 hrs; clear all day; 26-28°C; wind SW, 0-8 km/hr. Seven observers in four parties. Total party hours 18 (12 on foot, 6 by car); total party miles 14.5 (8.5 on foot, 6 by car). Observers: Ron Beck, Glen Gorlick, Jack Holtz, Sue Marquez, Tim Thomas (Stunt Ranch, Stunt Rd., Alabasas, CA 91302), Bill Van Nordon, Bob Wong. Conservation status, land uses: Most of the circle is within the boundary of the Santa Monica Mt. National Recreation Area. One L.A. Co. Park (Tapia), two State Parks (Malibu Lagoon and Malibu Cr.) and the Cold Cyn. Preserve of the Nature Conservancy were used as sites offering continued protection. Uniqueness of habitats: Malibu Lagoon contains 10 acres degraded salt march; Malibu Cr. St. Pk. has Valley Oak Savannah; Cold Cyn. Preserve is the center of an ecologically significant area (L.A. Co.). Imminent threats: Two of the sites are in proposed acquisition status for the SMMNRA but could be developed in the interim. Changes since last year: First year count. Danaus plexippus 62(C), Coenonympha california 56(C), Adelpha bredowi 30(C), Limenitis lorquini 10(C), Precis coenia 17(C), Euphydryas chalcedonia 1(C), Nymphalis antiopa 1 (C), Satyrium saepium 2(C), S. sylvinus 2(C), Strymon melinus 1(C), Lycaena arota 4(C), Brephidium exilis 4(C), Leptotes marina 15(C), Philotes battoides 13(C), Celastrina argiolus 1(C), Plebejus acmon 60(C), Colias harfordii 10(C), Pieris protodice 1(C), P. rapae 250(N), Papilio zelicaon 4 (C), P. rutulus 18(C), P. eurymedon 1(C), Panoquina panoquinoides 15(C), Ochlodes sylvanoides 1(C), Hylephila phyleus 10(C), Helioptes ericetorum 2(C), Pyrgus communis 1(C), Erynnis funeralis 2(C). Total 28 spp., about 594 indiv. Larvae seen: E. chalcedonia 100+ (on Keckiella cordifolia, Mimulus longiflorus). Field notes: Seemed quite dry. Next year will count as early in the period as possible.

ZONE 2: NORTHWEST
(Oregon, Washington)

Utopia, OR. 44°30'N, 121°W, center T12S R14E Sec 8, includes Willow Cr. Cyn., Grizzly Mtn., Crooked River, McMeen Spr., Litgow Spr., Lone Pine Cr., Skull Hollow, McGoin Stackyard Spr. Elev: 732-1719 m. Habitat coverage: Sagebrush/juniper grassland, Ponderosa pine/juniper woodland, marsh, riparian along springs, creeks and river. 12 July 1980; 1000-1800 hrs; clear all day; 20-28°C; winds slight. Twentysix observers in one to six parties. Total party hours 30 (all on foot); total party miles 20. Observers: Dan Ackman, Tim Barrow, Diane Belnavis, Carolyn Bohn, Bill Burton, Allan Chambers, Neil Cobb, Jennie Cornell, Letechia Cowan, Clinton Doyle, Eric Eaton, Charles Fosterlitz, Christie Galen (OMSI Research Center, 4014 SW Canyon Rd., Portland, OR 97221), Bruce Hansen, John Huckfeldt, George Hinkley, Eric Horvath, Andre Petett, Carol Savonen, Steve Shattuck, Kathy Smith, Stafford Squier, Dina Tanner, Joanne Vrilakas, Denise Williams, Erica Wolf. Conservation status; land uses: Grazing, recreation and some residential. Uniqueness: Many of the streams of the Crooked River Nat'l. Grassland are fenced to exclude cattle. The resulting riparian vegetation is unique since most of it has long since been eaten up. Imminent threats: Almost all land is managed by the U.S. Forest Service. Private land is being developed and one riparian site on Grizzly Mtn. has recently been developed adn posted. Changes since last year: None. Danaus plexippus 3(S), Cercyonis pegala 72(S), Coenonympha tullia 59(C), Limenitis lorquini 24(S), Phyciodes campestris 36(C), P. mylitta 37(C), Euphydryas chalcedonia 18(C), Polygonia satyrus 1(C), P. zephyrus 5(C), Vanessa atalanta 3(S), V. cardui 1(C), Nymphalis milberti 3(S), N. antiopa 1(S), Boloria selene 1(C), Satyrium behrii 2(S), S. californica 2(C), Callophrys nelsoni 48(C), Lycaena rubidus 1(N), L. helloides 1(N), Philotes battoides 8(C), Phaedrotes piasus 6(C), Glaucopsyche lygdamas 2(C), Plebejus melissa 24(C), P. acmon 1 (C), P. icariodes 71(C), Colias eurytheme 1(N), C. occidentalis 6(C), Pieris beckerii 16(C), P. occidentalis 20(C), P. napi 1(C), P. rapae 85(C), Papilio zelicaon 1(S), P. rutulus 1(S), P. multicaudatus 3(S), P. eurymedon 6(C), Hesperia juba 13(C). Total 37 spp., about 594+ indiv.

Portland, OR. 45°20'N, 122°45'W, center Insect Zoo, Washington Park (see 1978 report for description). Habitat coverage: Same as 1979. 28 June 1980; 1130-1530 hrs; mostly clear in AM to clear in PM; 12-23°C; wind NW, 0-19 km/hr. Eleven observers in three parties. Total party hours 9 (5 on foot, 4 by car); total party miles 88 (7 on foot, 81 by car). Observers: Tena Anthony, Jack Delaini, Eric Eaton, Kobel Haver, Sally Hughes, Stan Jewett, Lyfe Powers, Robert Pyle, Linda Teagan, Michelle Schneider, Roger Yerke (Washington Park Zoo, 4001 SW Canyon Rd., Portland, OR 97221). Conservation status, land uses: Much of it protected from development as city parks, open spaces or flood plain, but liable to management change. Uniqueness: Oak Bottoms in particular is a highly significant flower open space incl. meadow uplands and riverside woodlands. Skyline Ridge and associated Forest Park probably consist of one of the most impressive urban open spaces anywhere. Imminent threats: Off-road vehicle damage on Skyline Ridge and to a lesser degree at Oak Bottoms. Residential development of valley bottoms. Changes since last year: None. Coenonympha tulia 23(N), Limenitis lorquini 1(S), Polygonia satyrus 2(N), Vanessa atalanta 1(S), Celastrina argiolus 2(N), Pieris rapae 5(N), Papilio rutulus 40(S), P. eurymedon 1(S), Polites sonora 5(S). Total 9 spp., about 80 indiv. Field notes: P. rutulus observed nectering at purple vetch.

Western Wahkiakum Co., WA. 46°20'N, 123°30'W, center Swede Park, Gray's River, includes all of Western Wahkiakum Co. including Gray's Bay on the Columbia River, E to Skamokawa and southern Pacific Co. including the headwaters of the Gray's, Naselle and Willapa Rivers in the Willapa Hills. Elev: 0-800 m. Habitat coverage: Lowland and low hills coniferous forest, logged on to several times, perhaps 0.5% virgin remaining; primarily Douglas fir, Lowland Hemlock, Western Redcedar and Red Alder; and an array of riparian and agricultural habitats. 24 July 1980; 1400-1600; partly cloudy; 18-24°C; wind nil. One observer in one party. Total party hours 2 (1.5 on foot, .5 by car); total party miles 10 (2 on foot, 8 by car). Observer: Robert M. Pyle (Swede Park, Gray's River, WA 98621). Conservation status; land uses: Forestry and agricultural; nearly all privately owned. Uniqueness of habitats: Minute remaining virgin forest stands are unique in the area (Willapa Hills). The majority of the circle incorporates typical logged and dairy/cattle farmed in Southwestern Washington. Small features of more than usual interest will be investigated in future counts. Imminent threats: Any single forest site is liable to be logged. The agricultural lands are relatively stable as population and growth are low. Herbicide spraying in the forest lands constitute the greatest threat to continued diversity. Strymon melinus 1(C)(COUNTY RECORD), Pieris napi 1(N), Papilio rutulus 8(N), P. eurymedon 1(N), Parnassius clodius 2(N), Euphyes vestris 1(C)(COUNTY RECORD). Field notes: Although it was not possible to conduct the count within the formal period, it was deemed desirable to begin it this year. P. rutulus was observed visiting coyote scat. E. vestris and S. melinus are county records (the county is one of the least studied in Washington, as well as one of the smallest).

ZONE 3: ROCKY MOUNTAINS
(Colorado, Wyoming)

Cottonwood Pass, Gunnison-Chaffee Co., CO. See 1979 report for full habitat description. 25 July 1980; 0930-1330 hrs; clear in AM to mostly cloudy in PM; 14-22°C; wind NW, 3-25 km/hr. Six observers in five to six parties. Total party hours 23 (all on foot); total party miles 27. Observers: K. Bagdonas (Dept. of Zoo. & Phys., Univ. of Wyo., Laramie, WY 82071), William Bagdonas, Martie Crone, Dave Geiss, Brian Lowry, Fred Melius. Conservation status; land uses: Pass summit. Scenic parking area and very heavy traffic by hikers have resulted in some loss of tundra, especially in the dry 1980 summer. Uniqueness: Cottonwood Pass is an exceptionally beautiful alpine pass on the Continental Divide, and is a typical example. Imminent threats: Many hikers and tourists have eroded much of the dry tundra bordering the road and trails. Changes since last year: The tundra was the driest, in 1980, I have ever seen on Cottonwood Pass. Oeneis chryxus 70(S,C), O. uhleri 22(S,C), O. taygete 2(C), O. melissa 14 (S,C), O. polixenes 1(C), Erebia magdalena 7(S,C), E. epipsodea 33(S,C), E. callias 169+(S,C), Chlosyne damoetus 40(S,C), Euphydryas anicia 40(S,C), Speyeria mormonia 21(S,C), Boloria titania 28(S,C), Lycaena cupreus 23(S,C), Plebejus melissa 1 (C), P. saepiolus 17(S,C), P. shasta 194+(S,C), Agriades

glandon 16(S,C), Colias eurytheme 1(C), C. alexandra 5(S,C), C. occidentalis 12(S,C), C. meadii 79(S,C), C. scudderii 1 (C), Pieris napi 12(S,C), Parnassius phoebus 440+(S,C), Polites draco 20(S,C), Erynnis persius 1(C). Total 26 spp., about 1057 individuals. In 1980, 26 spp. were recorded compared to 33 in 1979. Although the season was several weeks behind normal again, this year was the driest I have ever seen on Cottonwood Pass. Not a single specimen of any of the usually common hibernators was seen. It was very unusual not to see any Vanessa, Polygonia, or Nymphalis at all. The cold wet spring and hot dry summer wilted flowers in the bud.

Hall Valley, Park Co., CO. See 1979 report for full description of habitat. 28 July 1980; 1000-1330 hrs; clear in AM to partly cloudy in PM; 21-24°C; wind NW, 4-22 km/hr. Six observers in five to six parties. Total party hours 17.5 (all on foot); total party miles 11. Observers: Karolis Bagdonas (Dept. of Zoo. & Phys., Univ. of Wyo., Laramie, WY 82071), William Bagdonas, Martie Crone, Dave Geiss, Brian Lowry, Fred Melius. Conservation status; land uses: Hall Valley is a US Nat'l Forest campground. The surrounding area is also used to graze cattle. Uniqueness: An early historic Lepidoptera collecting site. Imminent threats: Heavy grazing continues to damage meadow and willow bog habitats. In addition, increased use by campers has resulted in damage to meadows bordering the road and camping areas. Changes since last yr: Road improvements to increase accessability. Oeneis uhleri 3 (C), Erebia epipsodea 7(S,C), Cercyonis oetus 1(C), Coenonympha tullia 24(S,C), Limenitis weidemeyerii 4(S,C), Phyciodes tharos 14(S,C), P. campestris 34(S,C), Polygonia satyrus 5 (S,C), P. faunus 1(C), P. zephyrus 17(S,), Vanessa cardui 2 (C), V. virginiensis 1(C), Nymphalis milberti 20(S,C), N. antiopa 10(S,C), Speyeria aphrodite 14(S,C), S. atlantis 3(C), S. coronis 14(S,C), S. zerene 2(C), S. callippe 1(C), S. mormonia 87+(S,C), Boloria titania 8(S,C), Lycaena heteronea 1 (C), L. rubidus 29(S,C), L. dorcas 21(S,C), Glaucopsyche lygdamus 2(C), Plebejus melissa 1(C), P. saepiolus 67(S,C), Agriades glandon 7(C), Colias philodice 10(S,C), C. eurytheme 2(C), C. alexandra 71(S,C), Colias occidentalis 5(S,C), C. scudderii 15(S,C), Pieris napi 111(S,C), P. rapae 7(S,C), Euchloe ausonides 5(S,C), Papilio rutulus 15(S,C), P. multicaudatus 1(C), P. eurymedon 6(S,C), Polites draco 24(S,C), P. themistocles 1(C), P. sonora utahensis 1(C). Total 43 spp., about 526 indiv. Larvae seen: N. milberti 34 (on Urtica dioica) Field notes: 43 spp. recorded compared to 38 in 1979. This is the best year for this count, although numbers fo most spp. were down. S. callippe and S. zerene are COUNTY RECORDS for Park Co.

Kebler Pass-Erickson Springs, CO. 38°52.5'N, 107°12.5'W, center Lost Lake Campground. See earlier reports for description. 31 July 1980; 1200-1730 hrs; clear all day; 22-30°C; wind variable 0-5 km/hr. Two observers in one party. Total party hours 5.5 (3.5 on foot, 2 by car); total party miles 35 (3 on foot, 32 by car). Observers: Larry F. Gall (Dept. Biology, 257 OML, Yale Univ., New Haven, CT 06520), Felix Sperling. Conservation status; land uses; uniqueness of habitats: See 1978 report. Changes since last year: Not reported. Danaus plexippus 1(S), Oeneis chryxus 1(C), Cercyonis oetus 82(C), C. pegala 25(C), Limenitis weidermeyerii 7(C), Speyeria cybele leto 30(C), S. aphrodite 10(C), S. atlantis 7(C), S. callippe 25(C), S. mormonia 65(N), S. zerene 10(C), Boloria titania aelena 16(C), Hypaurotis crysalus 180(C), Satyrium calanus 6(C), S. sylvinus 13(C), Lycaena heteronea 9(C), L. rubidus 2(N), L. dorcas 2(N), L. nivalis 2(C), Plebejus icarioides 2(S), Everes amyntula 1(C), Colias philodice 1(S), C. eurytheme 8(N), C. scudderii 4(S), Pieris protodice 2(N), P. occidentalis 11(C), P. napi 18(C), P. rapae 2(N), Papilio rutulus 1(S), Poanes taxiles 5(N), Hesperia comma 9(N), Thorybes pylades 2(N). Total 32 spp., about 579+ indiv. Field notes: There was an enormous population explosion of Pseudohazis sp. in the hot oak-scrub chaparral on the ridges above Erickson Spg. The Catocala were slightly late, LFG saw but one fresh male each of C. aholibah and C. verrilliana. The previous winter saw a greater than normal snow pack followed by an extremely dry spring.

Maroon Lake, Pitkin Co., CO. See 1979 report for full description of habitat. 27 July 1980; 1000-1400 hrs; clear in AM to mostly clear in PM; 24-33°C; wind NW, 5-27 km/hr. Six observers in one to five parties. Total party hours 24 (all on foot); total party miles 16. Observers: Karolis Bagdonas (Dept. of Zoo. & Phys., Univ. of Wyo., Laramie, WY 82071), Willaim Bagdonas, Martie Crone, Dave Geiss, Brian Lowry, Fred Melius. Conservation status; land uses: This site is part of a national forest and is heavily used for recreational camping. Uniqueness: The most photographed scenic site in Colorado. Imminent threats: The heavy impact of a high use site. Changes since last year: None. Oeneis chryxus 5(S,C), O. uhleri 7(S,C), O. melissa 27(S,C), Erebia epipsodea 2(C), Cercyonia oetus 2(C), Coenonympha tullia 17(S,C), Limenitis weidemeyerii 7(S,C), Phyciodes tharos 6(S,C), P. campestris 6(S,C), Polygonia zephyrus 1(C), Nymphalis milberti 24(S,C), N. antiopa 4(S,C), Speyeria cybele 8(S,C), S. aphrodite 7(S, C), S. atlantis 3(C), S. coronis 5(S,C), S. zerene 6(C), S. callippe 3(S,C), S. mormonia 49(S,C), Lycaena heteronea 47 (S,C), L. rubidus 188+(S,C), L. dorcas 77+(S,C), Glaucopsyche lygdamus 1(C), Plebejus saepiolus 40(S,C), P. icarioides 2(C), Everes amyntula 3(C), Agriades glandon 8(C), Colias philodice 1(C), C. eurytheme 1(C), C. alexandra 7(S,C), C. occidentalis 8(S,C), Pieris protodice 1(C), P. napi 218+(S,C), P. rapae 1 (C), Papilio rutulus 11(S,C), P. multicaudatus 1(C), P. eurymedon 1(C), Polites draco 12(S,C), Erynnis persius 1(C). Total 40 spp., about 703 indiv. Larvae seen: N. milberti 57 (on Urtica dioica). Field notes: 40 spp. were recorded this year compared to 27 in 1979. This is the greatest number in the Maroon Bells area in the 4 years of our count. The area was very dry in keeping with the hot, dry summer of 1980 in Colorado. S. zerene is a COUNTY RECORD for Pitkin Co. Stress continues to plague the habitat; many thousands of visitors come to the area. Attempts by the US Forest Service to limit vehicular travel by busing and the erection of fences to keep hikers on routed paths have helped some, but the volume of people continues as the main problem.

Paonia Reservoir, Gunnison Co., CO. See 1979 report for full description of habitats. 23 July 1980; 1140-1545 hrs; clear in AM, heavy rain in PM; 27-32°C; wind NNW, 6-15 km/hr. Eight observers in one to seven parties. Total party hours 28.5 (28 on foot, 0.5 by car); total party miles 26.5 (24 on foot). Observers: Karolis Bagdonas (Dept. of Zoo. & Phys., Univ. of Wyo., Laramie, WY 82071), William Bagdonas, Corey Campbell, Marie Crone, Chuck Farber, Dave Geiss, Brian Lowry, Fred Melius. Conservation status; land uses: Recreation including camping, fishing and hiking. Also heavy cattle grazing. Uniqueness: Dry scrub oak forest bordering riparian woodland. Imminent threats: Additional road construction. Changes since last year: Upgrading and construction of roads continues to damage or destroy prime areas of habitat along Paonia Reservoir. Danaus plexippus 15(S,C), Cercyonis oetus 82(S,C), C. pegala 83(S,C), Limenitis weidermeyerii 9(S,C), Polygonia zephyrus 3(S,C), Nymphalis antiopa 1(S), Speyeria cybele 74 (S,C), S. aphrodite 104(S,C), S. atlantis 19(S,C), S. coronis 63(S,C), S. callippe 27(S,C), Agraulis vanillae 1(C), Hypaurotis crysalus 8(S,C), Satyrium behrii 1(C), S. liparops 8 (S,C), S. calanus 5(C), S. sylvinus 43(S,C), Lycaena arota 34 (S,C), L. rubidus 17(S,C), L. dorcas 21(S,C), Plebejus melissa 1(C), P. icarioides 4(C), Everes amyntula 2(C), Pieris napi 9(S,C), P. rapae 1(C), Papilio rutulus 14(S,C), P. multicaudatus 4(S), P. eurymedon 1(C), Euphyes vestris 2(C), Ochlodes sylvanoides 6(S,C), O. snowi 1(C), Oarisma garita 1(C), Polites themistocles 1(C), Piruna pirus 8(S,C), Thorybes mexicana 1(C). Total 35 spp.,about 533 indiv. Field notes: The season was again two weeks late, as in 1979. Even though some spp. normally common were absent this year, we recorded 35 spp. to compare with 28 in 1979. This is the greatest number in the four years of this count. Surprisingly, no Colias species were seen.

Rattlesnake Jack's, Skin Gulch, Larimer Co., CO. 40°40'N, 105°23'W, center Skin Gulch Creek just off Stove Prairie Rd, includes 1 km NW to ridge top, 2 km SW to end of gulch, 1 km SE to ridge top and 1 km SE to ridge top. Elev: 1836-2257 m. Habitat coverage: 10% riparian gulch bottom of meadows, and cottonwoods, aspen and willow stands, 55% juniper and scrub dry hillsides and ridge tops, 35% Ponderosa Pine and Douglas Fir forest. 13 July 1980; 1000-1300 hrs; clear all day, 23-33°C; wind E, 0-7 km/hr. Nine observers in six to nine parties. Total party hours 26 (all on foot); total party miles 3. Observers: Karolis Bagdonas (Dept. of Zoo. & Phys., Univ. of Wyo., Laramie, WY 82071), Corey Campbell, Martie Crone, Chuck Farber, Dave Geiss, Ira Heller, Brian Lowry, Fred Melius, Roberta Skinner. Conservation status; land uses: Roosevelt Nat'l. Forest. The area is used for camping. Uniqueness: Typical foothills habitat of lush riparian gulch with drier hillsides. Imminent threats: Heavy road damage, open

campfires, wood cutters and a general increase in use. Oeneis chryxus 1(C), O. uhleri 7(S), Cercyonis oetus 48(S,C), C. pegala 25(S,C), Asterocampa celtis 1(C), Limenitis weidemeyerii 17(S,C), Phyciodes tharos 41(S,C), P. campestris 53(S,C) P. pallida 15(S,C), Chlosyne gorgone 1(C), C. nycteis 6(S,C), C. palla 22(S,C), Euphydryas anicia 17(S,C), Polygonia satyrus 5(S,C), P. zephyrus 14(S,C), Vanessa atalanta 7(S), Nymphalis milberti 5(S,C), N. antiopa 9(S,C), Speyeria aphrodite 96(S,C), S. atlantis 41(S,C), S. coronis 20(S,C), S. zerene 2(C), S. callippe 28(S,C), Harkenclenus titus 5(S,C), Boloria behrii 22(S,C), Satyrium liparops 2(C), S. californica 48(S,C), Callophrys siva 52(S,C), Strymon melinus 5(S,C) Lycaena heteronea 35(S,C), L. rubidus 7(S,C), Philotes enoptes 13(S,C), Plebejus melissa 9(S,C), P. saepiolus 7(S,C), P. icarioides 3(C), P. acmon 10(S,C), Everes amyntula 1(C), Agriades glandon 15(S,C), Colias philodice 10(S,C), C. eurytheme 1(C), C. alexandra 35(S,C), C. occidentalis 7(S,C), Pieris napi 4(S,C), P. rapae 41(S,C), Papilio zelicaon 1(C), P. rutulus 15(S,C), P. multicaudatus 22(S,C), P. eurymedon 27(S,C), Parnassius phoebus 48+(S,C), Euphyes vestris 13(S,C) Poanes taxiles 25(S,C), Atrytone arogos iowa 1(C), Oarisma garita 1(C), Polites themistocles 3(S,C), Piruna pirus 18(S, C), Erynnis persius 1(C), Epargyreus clarus 3(S,C). Total 57 spp., about 869 indiv. Larvae seen: P. zelicaon 3 (on Angelica sp.). Field notes: This is the first Xerces count for this site although it has been a favorite collecting place since 1969. 1980 is the driest summer since we've begun keeping records. The site takes its name from Rattlesnake Jack, a World War I veteran who returned home to the US, moved his family to Skin Gulch, and raised them as Apache Indians.

Weston Pass, Lake-Park Co., CO. See 1979 report for complete description of habitat. 26 July 1980; 0930-1600 hrs; clear all day; 24-32°C; wind NW, 5-30 km/hr. Six observers in one to six parties. Total party hours 37 (all on foot); total party miles 41. Observers: Karolis Bagdonas (Dept. of Zoo. & Phys., Univ. of Wyo., Laramie, WY 82071), William Bagdonas, Martie Crone, Dave Geiss, Brian Lowry, Fred Melius. Conservation status; land uses: Remote area of Pike Nat'l. Forest, little impact by man. Uniqueness: A high alpine area on a rugged road surrounded by high ridges and talus slopes. Imminent threats: None at present. Changes since last year: None. Oeneis chryxus 58+(S,C), O. uhleri 90+(S,C), O. melissa 33(S,C), Erebia magdalena 32(S,C), E. epipsodea 152+(S,C), E. callias 308+(S,C), Limenitis weidermeyerii 1(C), Chlosyne damoetus 409+(S,C), Euphydryas anicia 400+(S,C), Polygonia zephyrus 6(C), Nymphalis milberti 10(S,C), Speyeria atlantis 35(S,C), S. zerene 1(C), Boloria eunomia 6(S,C), B. titania 550+(S,C), Lycaena heteronea 1(C), L. rubidus 7(S,C), L. dorcas 44(S,C), L. cupreus 10(S,C), Glaucopsyche lygdamas 1(C), Plebejus saepiolus 182+(S,C), P. icarioides 1(C), P. shasta 217+(S,C), Agriades glandon 71+(S,C), Colias alexandra 9(S,C) C. occidentalis 5(S,C), C. meadii 347+(S,C), Pieris napi 37 (S,C), Parnassius phoebus 396+(S,C), Polites draco 305+(S,C), Pyrgus centaurae 1(C), Erynnis persius 1(C). Total 32 spp., about 3525 individuals. Field notes: Alpine season about two weeks behind again this year, but the area was much drier than in 1979. However, Weston Pass was much greener and more lush than surrounding areas at the same time. Most populations were on the upswing. Although the number of spp. seen dropped from 35 to 32, numbers per spp. increased sharply over 1979.

Rocky Mountain Nat'l. Park, CO. 40°20'N, 105°40'W, center at Bear Lake, RMNP. See 1978 report for further description. 9 July 1980; 0900-1700 hrs; AM-mostly clear, PM-partly cloudy; 18-23°C; winds varying, 5-20 km/hr. Eight observers in one to two parties. Total party hours 10 (6.5 on foot, 3.5 by car); total party miles 80 (5 on foot, 75 by car). Observers: Barb Brown, Jan Chu, Sally Hughes, Mary Jane Foley, Molly Muller, Robert M. Pyle (Swede Park, Gray's River, WA 98621), Josie Quick, Ron Wahl. Conservation status; land uses: Most of the circle fully protected within Rocky Mountain Nat'l. Park. Lower atitudes vulnerable to development and grazing, and development is progressing in the Fish Creek area. Uniqueness of habitats: See 1978 report. Imminent threats: Mountain home development outside the national park. Changes since last year: None cited. Danaus plexippus 2(S), Oeneis chryxus 16(N), O. melissa 8(S), Erebia magdalena 23(S), E. epipsodea 4(N), Coenonympha tullia 130(N), Limenitis weidemeyerii 4(S), Phyciodes tharos 55(N), P. campestris 32(N), Chlosyne nycteis 25 (N), C. palla 9(N), Poladryas arachne 3(N), Euphydryas anicia 6(N), Polygonia zephyrus 1(N), Vanessa cardui 2(S), V. virginiensis 1(N), Nymphalis milberti 8(N), N. antiopa 3(S), Euptoieta claudia 1(S), Speyeria aphrodite 2(N), S. atlantis 2(N), Glaucopsyche lygdamus 2(N), Callophrys apama 2(N), Lycaena rubidus 2(N), L. heteronea 50(N), Hemiargus isola 1 (N), Plebejus melissa 2(N), P. saepiolus 27(N), P. acmon 47 (N), Agriades glandon 19(N), Everes amyntula 1(N), Colias philodice 5(N), C. eurytheme 6(N), C. alexandra 62(N), Pieris rapae 4(S), Euchloe ausonides 1(S), Papilio rutulus 12 (S), P. multicaudatus 4(S), P. eurymedon 1(N), Parnassius phoebus 193(N), Oarisma garita 65(N), Pyrgus communis 1(N). Total 43 spp., about 755 indiv. More counters covering more and new areas accounted for higher number of species, along with an unusual season which for some species was early and for others, late. For example, there were still a few worn C. apama, yet E. epipsodea was nearly over. E. magdalena seemed to be having an excellent emergence in arctic-alpine parts of the park.

Highline Canal, CO. 39°45'N, 104°40'W, center The Hollow Tree, Del Mark Park, Aurora, includes (but see changes since last year) see previous report, 1979. Habitat coverage: see 1979 report. 21 July 1980; 1000-1300 hrs; sky clear; 27-32°C; wind W, 5-10 km/hr. Three observers in one party. Total party hours 3 (all on foot); total party miles 3. Observers: Lynelle Jones, Robert M. Pyle (Swede Park, 123 Loop Rd., Gray's River, WA 98621), Ron Wahl. Conservation status; land uses: The central section of the count area has now been almost wholly developed. Only weedy fragments of habitat remain and most specialized organisms are locally extinct. Uniqueness: Elsewhere in the count circle notable habitat remnants remain. The section in which the Highline Canal and Tollgate Creek cross still retains local interest. Imminent threats: Nearly all habitats of any natural character whatever in the count circle are under threat from expanding development. The narrow right-of-way and trail along the canal is often violated by developers and offers diminishing sanctuary for species. Changes since last year: Heavy flooding along Tollgate Creek due to housing area channelization has cut back banks considerably, eroding already minimal habitat. The count circle's center, the ancient Hollow Tree (Plains Cottonwook) in Del Mar, parially fell during snowstorms last winter; the Aurora Parks Dept. removed the tree entirely. Danaus plexippus 2(S), Cercyonis pegala 4(N), Phyciodes campestris 2(N), Chlosyne gorgone 6(N), Vanessa cardui 2(S), Nymphalis antiopa 5(S), Lycaena xanthoides 8(N), L. rubidus 4(N), Plebejus melissa 1(N), Colias philodice 3(N), C. eurytheme 2(S), Pieris protodice 3(N), P. rapae 100+(N), Papilio polyxenes 2(N), Pholisora catullus 2(N). 15 species total, about 164 indiv. Field notes: Due to conflicts, the count had to be held later and with fewer participants than in previous years, and covered a smaller area. It was conducted in spite of being past the formal count period since continuity is desirable. The area covered has been observed by the compiler for the past 22 years. The conclusion reached is that this area has almost completely lost its natural values. Only weedy, adventive and highly vagile species remain, whereas the same area hosted a diverse array of butterflies including a number of specialists in the 1950's and 1960's. Suburban residential and commercial development has been the cause of species loss. The Highline Canal Trail, intended by planners to save natural conditions along a greenbelt corridor, has largely failed due to inadequate protection of the right-of-way itself and of a minimum of adjacent habitats. Developers have grossly violated regulations and environmental sense by dumping excess fill and waste material into the Tollgate Creek and the Highline Canal. The same end result probably faces other, heretofore less developed portions of the canal's perimeter within the count circle.

Gilpin Co., CO (Upper Circle). 39°55'N, 105°35'W, center 3 km NNE of Apex, includes East Portal, Rogers Pass, Caribou, Dory Hill, Golden Gate Cyn. St. Pk. Elev: 2380-4045 m. Habitat coverage: see 1979 report. 13 J ly 1980; 0900-1400 hrs; clear in AM, PM mostly cloudy with intermittent to moderately heavy rain; 5.6-23°C; winds variable, 0-30+ km/hr. Ten observers in seven parties. Total party hours 16 (12 on foot, 4 by car); total party miles 65 (30 on foot, 35 by car). Observers: Charles V. Covell, Jr., Charles V. Covell, III, Donald, Rank adn Nancy Eff, Mike Fisher, Don Phillipson, Charles Slater, Katherine Stanford, Scott Stanford, Ray E. Stanford (720 E. Fairfax St., Denver, CO). Conservation status; land uses; uniqueness of habitats: see earlier reports. Imminent threats: None. Changes since last year: Unfortunately, the Henry Toll Ranch at East Portal, a prime collecting spot for four des-

cades, has been leased to a private hunting club. I have been assured by Dr. Henry Toll, who owns the land and is responsive to conservation needs, that permission to continue our observations here will be given. Oeneis chryxus 11(C), O. melissa lucilla 24(C), Erebia magdalena 8(C), E. epipsodea epipsodea 22(C), E. callias 1(C), Cercyonis oetus 7(S), Coenonympha tullia ochracea 37(C), C. ampelos 10(C), Limenitis weidemeyeri 2(S), Phyciodes tharos 9(C), P. campestris camillus 19(C), Chlosyne gorgone carlota 1(C), C. palla calydon 4(C), C. damoetas 2(C), Poladryas arachne 2(C), Euphydryas anicia crucei 3(C), Polygonia zephyrus 6(C), Nymphalis milberti furcillata 2(S), N. antiopa 4(S), N. californica 1 (C), Speyeria aphrodite ethne 1(C), S. atlantis hesperis 32 (C), S. mormonia eirynome 2(C), Boloria titania 3(N), Lycaena heteronea 28(N), L. nivalis browni 2(C), Philotes enoptes ancilla 1(C), Plebejus saepiolus whitmeri 95(C), P. icarioides lycea 4(N), P. shasta pitkinensis 1(C), P. acmon 2(C), P. aquilo 45(C), Colias philodice eriphyle 1(N), C. eurytheme 7(C), C. a. alexandra 31(C), C. occidentalis 2(C), C. m. meadii 21 (N), C. s. scudderii 7(C), Pieris protodice 2(C), P. n. mcdunnoughi 44(C), Euchloe ausonides 7(C), Papilio r. rutulus 6(C), P. eurymedon albanus 1(C), Parnassius phoebus sayii 72(C), Oarisma g. garita 8(C), Polites draco 2(C), P. sonora utahensis 2(C), P. themistocles 4(N), Erynnis persius fredericki 5(C), E. i. icelus 3(C), Thorybes mexicana 3(N). Total 51 spp., about 613 indiv. Field notes: We were able to tally a remarkable high total number of species despite extremely dry conditions by with a "catch 22" rainy afternoon, because we had a more organized effort and more collectors in the field than in any prior year. This effort compares with 60 species (about 1500 indiv.) in 1978 and 55 species (about 611 indiv.) in 1979, both good seasons with unusually good weather. Interestingly (see separate on Lower Circle), we observed a new record 102 total species in the two overlapping circles in 1980, beating the 101 record set in 1978. We believe this to be a North American record for number of butterfly species observed by a single group in a single day. Give us a good day, in a good year, with the fine group of observers we had this year, and we'll find 120 spp. or more! Surely in our double circle, with an aggregate dia. of about 25 miles, we have more species in mid-July than anywhere else north of Mexico in North America. Perhaps a concerted effort in southern Texas, Florida or Arizona in late summer or early fall could beat us, and I hope someone will try; meanwhile, we will try to surpass our won records in 1981! E. callias and C. damoetas, both collected near Rogers Pass by Don Phillipson, are new species for the Upper Circle count; O. melissa (by Phillipson) and P. themistocles (by Mike Fisher) are new county records for Gilpin Co. Oddly, no V. cardui were seen in either circle.

Gilpin Co., CO (Lower Circle). 39°50'N, 105°20'W, center Golden Gate Cyn. Rd. S of Centralia Mtn., includes North Clear Cr., Golden, Coal Cr. Elev: 1770-3200 m. Habitat coverage: as described previously. 13 July 1980;0700-1400 hrs; clear in AM to mostly cloudy with intermittent light to moderate to heavy rain; 9-28°C; winds variable, 0-30+ km/hr. Twelve observers in seven to eight parties. Total party hours 20 (16 on foot, 4 by car); total party miles 89 (14 on boot, 75 by car). Observers: Dale Barlow, Charles V. Covell, Jr., Charles V. Covell, III, Peter Eades, Donald Eff, Mike Fisher, Lowell Harris Robert Price, James Scott, Katherine Stanford, Sctott Stanford, Ray E. Stanford (720 Fairfax St., Denver, CO 80220). Conservation status; land uses: The classic locality of Indian Gulch in Clear Creek Cyn. has been fenced off from target shooters, who had nearly ruined the habitat; we now need to obtain permission from the owners to collect there again. Uniqueness: This is the "Chimney Gulch" habitat of Ernest Oslar, who collected the types of many of Ewards's named taxa. Hopefully, a Clear Cr. Cyn. St. Pk. will be created in the future, with this classic gulch a nature trail. Of course, permission will need to be granted to collect there if such should occur. Imminent threats: See above. Most of Clear Cr. Cyn., one of the most scenic canyons in the Rockies, is private property. Iplan to work with the Colorado Open Space Council and the Natural Areas Program to get much of this canyon preserved. Changes since last year: See Above; if anything, things are looking up in terms of preserving the canyon. Foothills are another subject; they contunue to be sold as housing tracts, and many prime collecting spots are gone. Danaus plexippus 1(S), Oeneis chryxus chryxus 2(C), Erebia epipsodea 13(C), Cercyonis pegala boopsis 193(C), C. oetus charon 235 (C), Coenonympha tullia ochracea 25(C), Euptychia dorothea 10(C), Asterocampa celtis montis 24(C), Limenitis weidemeyeri 11(N), Phyciodes tharos 3(S), P. campestris camillus 9(C), P. p. pallida 3(C), Chlosyne gorgone carlota 10(C), C. nycteis drusius 2(N), C. palla calydon 2(C), Poladryas arachne 6(C), Euphydryas anicia capella 2(C), Polygonia satyrus 1(C), P. zephyrus 6(C), Vanessa atalanta rubria 3(S), Nymphalis milberti furcillata 2(C), N. californica 2(S), N. antiopa 17(S), Euptoieta claudia 3(S), Speyeria aphrodite ethne 59(C), S. edwardsii 3(N), S. atlantis hesperis 73(C), S. coronis halcyone 11(C), S. callippe meadii 58(C), Apodemia nais 25(C), Harkenclenus titus 13(C), Satyrium behrii crossi 8(C), S. saepium provo 29(C), S. liparops aliparops 11(C), S. californica 1(C), S. acadica montanensis 1(C), Callophrys eryphon 1(S), C. spinetorum 3(C), C. s. siva 4 (N), C. apama homoperplexa 4(C), Strymon melinus franki 11 (C), Lycaena heteronea 161(C), L. xanthoides dione 4(C), L. rubidus sirius 4(C), L. helloides 1(N), Leptotes marina 6(C), Hemiargus isola alce 3(C), Philotes enoptes 4(C), Glaucopsyche lygdamas oro 1(N), Celastrina argiolus cinerea 1(C), Plebejus melissa 4(C), P. saepiolus whitmeri 29(C), P. icarioides lycea 5(C), P. aquilo rustica 5(C), P. acmon texanus 3(C), Everes amyntula 1(N), Colias philodice eriphyle 3(C), C. eurytheme 1(S), C. a. alexandra 26(C), Eurema mexicana 1 (S), Pieris (Pontia) protodice 2(C), P. (Artogeia) rapae 53 (N), Euchloe ausonides coloradensis 2(N), Papilio polyxenes asterius 13(C), P. b. bairdii 1(C), P. i. indra 6(C), P. r. rutulus 13(C), P. multicaudatus 17(C), P. eurymedon albanus 2(C), Parnassius phoebus sayii 39(C), Euphyes vestris kiowah 43(C), Poanes t. taxiles 10(C), Atrytone arogos iowa 35 (C), A. logan lagus 6(C), Ochlodes s. snowi 2(C), Hesperia uncas uncas 1(C), H. ottoe 2(C), H. p. pahaska 2(C), H. viridis 6 (C), Oarisma g. garita 12(C), Polites draco 1(C), P. themistocles 6(C), Piruna pirus 61(C), Pyrgus c. communis 1(C), Erynnis persius fredericki 3(C), Epargyreus clarus 5(C). 86 total spp., about 1509 indiv. Field notes: The best ever team effort in this 6th annual Gilpin County "Lower Circle" count resulted in 86 spp. vs 89 in 1978 because of extremely dry conditions (most spp. down in numbers, and nearly all spring spp. gone) and very few exotic spp. Also we got rained out by 1500 hrs, preventing our usual late afternoon campaign for "missed" spp. (it rained from 1500 hrs until the next AM). The total of 1509 indiv. specimens observed compares with 2100 in 1978. 5 new spp. were taken this year: H. uncas, H. ottoe, P. bairdii, S. acadica and L. helloides; also a beautiful form"pseudoamericus" of P. polyxenes was taken by Dale Barlow. L. helloides is a token Jefferson Co. record (recorded earlier by several observers but not separated from dorcas). Total spp. observed in upper and lower circles by the entire group was 102, a new North American record (beating our 101 of 1978). Totals for both circles, 1975 through 1980: Lower circle 115 (theoretical max 120); Upper circle 94 (theoretical max 100); combined 136 (max 150).

Snowy Range, WY. 45°22'N, 106°15'W, center Univ of Wyoming Science Camp, includes (T16N R78-79W) Centennial, Libby Cr., Brooklyn Lk., Medicine Bow Peak, Sand Lake Road, Mirror Lk., Libby Flats, Libby Lks. Elev: 2600-3300 m. Habitat coverage: Mainly Canadian and Hudsonian zone forest, all below treeline with some sagebrush steppe habitats and riparian ones; few bogs and marshes. 20 July 1980; 1000-1530 hrs; clear to mostly clear; 16-24°C; wind WSW, 5-10 km/hr. Twenty-seven observers in four parties. Total party hours 22 (12 on foot, 10 by car); total party miles 40 (16 on foot, 24 by car). Observers: Party 1: Nelson Curtis, Peter Eades, Clifford Ferris (leader), Larry Gall, John Lane, Ray E. Stanford (720 Fairfax St., Denver, CO 80220); Party 2: Robert Pyle, Sally Hughes; Party 3: Floyd, June and Steve Preston; Party 4: Karolis Bagdonas, PeeWee Bagdonas, Corey Cambell, Terry Clifford, Betty, Rob't., and Dana Davis, Mark Harrington, Ira Heller, Brian Lowry, Tom McGann, Fred Melius, Alma Overstreet, Mike Rehg, Robbie Skinner, Lisa Snyder. Conservation status; land uses: All localities sampled are in Medicine Bow Nat'l. Forest, or small private parcels within same, Albany Co., WY. There is some light grazing by cattle here and there. Uniqueness: Ferris may wish to comment here; a few subspp. may be endemic to the Snowy Range? I know of none that occur only there. Imminent threats: None ot my knowledge. Changes since last year: First visit. Oeneis chryxus 89(C), O. uhleri 2(C), Erebia epipsodea 11(C), Cercyonis oetus 18(C), Limenitis weidermeyeri 7(C), Phyciodes tharos 2(C), P. campestris 31(C), Chlosyne palla calydon 8(C), Euphydryas anicia 5(C), E. editha alebarki 2 (C), Polygonia zephyrus 14(C), Nymphalis milberti 39(C), N. antiopa 3(C), Speyeria edwardsii 27(C), S. atlantis hesperis 2(C), S. coronis halcyone 3(C), S. zerene sinape 17(C), S. callippe meadii 2(C), S. hydaspe sakuntala 1(C), S. mormonia eurynome 95(C), Boloria eunomia laddii 42(C), B. selene tollandensis 5(C), B. freija browni 10(C), B. titania belona 89

(C), Satyrium fuliginosum 1(S), Lycaena heteronea 4(C), L. dorcas castro 56(C), Philotes enoptes ancilla 1(C), Glaucopsyche lygdamus 3(C), Plebejus saepiolus 140 (C), P. icarioides 131(C), P. shasta 3(C), P. acquilo 84(C), Everes amyntula 1(C), Colias philodice 9(C), C. alexandra 19(C), C. occidentalis 32(C), C. meadii 188(C), C. scudderii 66(C), Pieris protodice 6(C), P. napi 80(C), P. rapae 6(C), Euchloe ausonides 25(C), Papilio zelicaon 1(C), P. rutulus 2(C), P. multicaudatus 4(C), P. eurymedon 1(C), Parnassius phoebus 303 (C), Hesperia comma 3(C), Oarisma garita 4(C), Polites draco 23(C), P. sonora 1(C), Pyrgus centaureae 28(C). Total 58 spp, about 1767 indiv. Field notes: We enjoyed a nearly totally clear day, apparently an unusual event in the Snowy Range. A marvelous time was had by all participants, the pace broken momentarily when Party 1 paused to attend the broken ankle of a tourist. No county records were noted, although P. shasta (closest to pitkinensis) and S. hydaspe sakuntala are considered good records for the region (CDF). The only sp. incl. on the basis of a single sight record is S. fuliginosum, by RES, and is considered about 90% sure; it could have been a fresh, large dark female P. icarioides, but I'll stick to my eyesight! Party 1 observed 12 spp. not observed by any others, and Party 4 observed 9 not observed by others; I wonder whether "protodice" and our "occidentalis" may represent the same sp. For the moment, I accept their protodice if they accept my fuliginosum!

Colter Canyon, Grand Teton Nat'l Park, WY. See 1979 report for full description. 5 July 1980; 0930-1730 hrs; clear in AM to partly cloudy in PM; 20-29°C; wind S, 2-23 km/hr. Four observers in one to four parties. Total party hours 32 (all on foot); total party miles 18. Observers: M. Sterling Blanche, Mark S. Harrington, Thomas McGann (c/o Dr. Karolis Bagdonas, Dept. of Zool. & Physiol., Univ. of Wyo., Laramie, WY 82071), Michael T. Rehg. Conservation status; land uses: Grand Teton Nat'l. Park. This is a very remote region with no trails into Colter Cyn. and minimal use. Uniqueness of habitat: Although talus and mountains are abundant in GTNP, this area is unique because the lower portions of Colter Cyn. burned in 1973 and the understory is quickly revegetating. Imminent threats: None. Oeneis melissa 37(S,C), Erebia magdalena 27(S,C), Coenonympha haydenii 3(S), Phyciodes campestris 1(C), Chlosyne palla 8(S,C), Polygonia zephyrus 9(S,C), Vanessa cardui 4(S,C), V.annabella 1(C), Nymphalis milberti 51(S,C), Callophrys euryphon 1(C), Strymon melinus 1(C), Lycaena cupreus 1(C), Philotes enoptes 6(S,C), Phaedrotes piasus 1(C), Glaucopsyche lygdamus 8(S,C), Pieris sisymbrii 29 (S,C), P. protodice 10(S,C), P. napi 3(S), Anthocaris sara 3 (S), Papilio zelicaon 2(C), P. eurymedon 4(S), P. rutulus 4 (S), Caterocephalus palaemon 3(S,C), Pyrgus communis 10(S,C), Erynnis persius 3(S). Total 25 spp., about 239 individuals. Field notes: This year's season was approx. two weeks later than 1979 resulting in some changes in floral composition and butterfly diversity. The winter was very severe, spring wet followed by a dry summer. Number of spp. recorded increased by 4 from 1979. The count and additional work this year are part of a continuing study of the lepidopteran fauna of GTNP and is supported by grants from the Univ. of Wyo. and the Nat'l. Park Service.

Lost Creek, Grand Teton Nat'l. Park, WY. See 1979 report for full description. 8 July 1980; 1100-1600 hrs; mostly cloudy all day; 17-20°C; wind S, 0-2 km/hr. Four observers in one to four parties. Total party hours 20 (all on foot); total party miles 16. Observers: M. Sterling Blanche, Mark S. Harrington, Thomas M. McGann (c/o Dr. K. Bagdonas, Dept. of Zoo. & Phys., Univ. of Wyo., Laramie, WY 82071), Michael T. Rehg. Conservation status; land uses: Grand Teton Nat'l. Park. Horse riders travel through the area twice a day on established trails. There is very little traffic on Lost Cr. Road. Uniqueness of habitat: Most of the area is sagebrush flats with a few aspen draws. It is characteristic of the SW third of GTNP. Imminent threats: None. Changes since last year: None. Danaus plexippus 1(S), Erebia epipsodea 47(S,C), Cercyonia oetus 3(C), Coenonympha haydenii 42(S,C), C. tullia 124(S,C), Phyciodes campestris 5(S,C), Euphydryas editha 19 (S,C), Speyeria callippe 15(S,C), S. mormonia 7(S,C), Limenitis weidermeyerii 2(S), Callophrys affinis 4(S), Lycaena heteronea 2(C), Philotes enoptes 58+(S,C), Phaedrotes piasus 7(S,C), Glaucopsyche lygdamas 11(S,C), Plebejus melissa 4(S, C), P. saepiolus 32(S,C), P. icarioides 16(S,C), P. acmon 19 (S,C), Pieris napi 4(S,C), Papilio rutulus 12(S,C), Parnassius phoebus 24(S,C), Hesperia comma 4(C), Erynnis persius 39(S,C). Total 24 spp., about 468 indiv. Field notes: The count day was inclement.

Signal Mountain, Grand Teton Nat'l. Park, WY. See 1979 report for full description. 6 July 1980; 0945-1345 hrs; clear all day; 14-28°C; wind SSW, 3-45 km/hr. Four observers in one to three parties. Total party hours 16 (all on foot); total party miles 4. Observers: M. Sterling Blanche, Mark S. Harrington (c/o Dr. K. Bagdonas, Dept. Zoo. & Phys., Univ. of Wyo., Laramie, WY 82071), Thomas M. McGann, Michael T. Rehg. Conservation status; land uses: Grand Teton Nat'l Park. A park road borders the NW edge of the study site leading to several scenic overlooks. However, the extremely steep grade over most of the area prevents much disturbence. Uniqueness: The Signal Mountain area is representative of the lower hills covering approx. one third of GTNP. Imminent threats: None. Changes since last year: None. Coenonympha haydenii 46(S,C), Limenitis weidermeyerii 1(C), Phyciodes campestris 6(S,C), Chlosyne palla 6(S,C), Polygonia zephyrus 1(C), Nymphalis milberti 2(S), Speyeria atlantis 1(C), S. callippe 15(S,C), S. egleis 2(C), S. mormonia 80(S,C), Boloria kriemhild 1(C), Callophyrs affinis 2(S), Lycaena heteronea 3(S,C), L.nivalis 1(C), Philotes enoptes 64(S,C), Phaedrotes piasus 3(S,C), Glaucopsyche lygdamus 9(S,C), Plebejus acmon 4(C), Agriades glandon 51(S,C), Anthocaris sara 3(S,C), Euchloe ausonides 1 (C), Papilio rutulus 11(S,C), P. eurymedon 6(S), Parnassius phoebus 28(C), P. clodius 12(S,C), Erynnis persius 8(S,C). Total 26 spp., about 356 indiv. Note: The Signal Mtn. count is part of a general study of the lep. fauna of GTNP supported by grants from the Univ. of Wyo. and the Nat'l. Park Svc.

ZONE 4: GREAT PLAINS
(Nebraska)

Rowe Sanctuary, NE. 40°47'30"N, 98°52' 30"W, includes SE ¼ T8N R14W Sec 11. Elev. 634-645 m. Habitat coverage: 40% alfalfa, 30% Spartina sp. grassland, 30% riparian forest. 4 July 1980; 0900-1100 hrs; mostly clear; 22-27°C; wind S, 0-5 km/hr. Five observers in one party. Total party hours 2 (by car); total party miles 2. Observers: John C.W. Bliese, Mark Ferguson, Glennis L. Nagel, Harold G. Nagel (Rt. 3, Kearny, NE 68847), Lyle White. Conservation status; land uses: Audubon Bird Sanctuary. Imminent threats: None. Changes since last year: Alfalfa fields had been cut this year and few blossoms were present. Danaus plexippus 3(N), Cercyonis pegala 25(N), Phyciodes tharos 1(N), Speyeria idalia 66(N), Plebejus melissa 2(N), Everes comyntas 16(N), Colias eurytheme 12(N), C. philodice 2(N), Pieris protodice 1(N), P. rapae 1(N). Total 10 spp., about 129 individuals.

ZONE 5: Eastern-Midwest
(Illinois, Ohio)

McGraw Wildlife Foundation, IL. 42°04'N, 88°08'W, center SW corner Sec 36, Barrington Twp., includes East Dundee, Elgin Airport and west side of Elgin, S to Keeneyville and Bartlett, W to Arlington Hgts., N. through Barrington and Barrington Hills. Elev: 212-290 m. Habitat coverage: 26% open fields, 24% deciduous woods, 14% thickets and fence rows, 13% residential, 10% marsh, 7% conifer stands (planted), 6% water. 11 July 1980; 0945-1700 hrs; mostly clear in AM to partly cloudy in PM; 18.5-35°C; wind SW, 20-28 km/hr. Three observers in one to three parties. Total party hours 16 (6 on foot, 10 by car); total party miles 20.8 (4.3 on foot, 16.5 by car). Observers: George V. Burger (1766 Country Knolls Lane, Elgin, IL 60120), Douglas Hartman, Robert A. Montgomery. Conservation status; land uses: 10% in Cook Co. forest preserves, 15% in Max McGraw Wildlife Foundation (private), open on a restricted basis. Remainder primarily farmed or open (and subject to development) or residential. Uniqueness: Area includes "Bluff City Blvd. Cemetary" Fen, an area under study by the Illinois Nature Preserve Commission and other groups. Botanical surveys (preliminary) indicate that this site may be the state's most unique natural area. Imminent threats: Off-road vehicle damage to Fen. Signs, fencing and patrols have reduced this threat. Changes since last year: First year report. Danaus plexippus 2(N), Cercyonis pegala 5

(N), Euptychia cymele 39(N), Lethe portlandia 3(N), L. eurydice 29(N), Asterocampa celtis 1(S), Limenitis astyanax 10 (N), L. archippus 6(N), Phyciodes tharos 6(N), Chlosyne nycteis 4(C), Euphydryas phaeton 6(N), Polygonia interrogationis 1(S), P. comma 1(N), Vanessa atalanta 1(S), Nymphalis antiopa 1(S), Speyeria cybele 24(N), Harkenclenus titus 1(C), Satyrium liparops 2(N), S. edwardsii 5(N), Strymon melinus 1 (N), Colias philodice 54(N), C. eurytheme 15(N), Pieris rapae 104(N), Papilio polyxenes 2(S), P. glaucus 1(S), Euphyes conspicua 2(C), Poanes massosit 4(C), Atrytone delaware 3(C), Thymelicus lineola 100+(C), Epargyreus clarus 2(C). Total 30 spp., about 425 indiv. Field notes: Fen area contained the only colony of E. phaeton in the count area and the largest group of L. eurydice. This area is owned by a utility co. and we have hopes of state purchase and protection. T. lineola present in the 100's in grassland areas about 2 weeks prior to count. S. cybele noticeably more common than in previous 13 years of observation. P. glaucus continues rare.

Cleveland Heights-Holden Arboretum, OH. 41°30'N, ca. 81°W, center near Mayfield, includes suburban Cleveland, Holden Arboretum, Squire Valleevue (owned by Case Reserve Univ. for farming and ecological projects). Elev: 350-450 m. Habitat coverage: 50% open fields, 30% woods (oak, maple, beech), 10% ponds and river roadside, 10% residential. 13 July 1980; 1000-1630 hrs; clear all day; 26-28°C; wind NW, 1-10 km/hr. One observer in one party. Total party hours 6.5 (4.5 on foot, 2 by car); total party miles 31 (5 on foot, 26 by car). Observer: Julie Clemens (2258 Lamberton Rd., Cleveland Hgts., OH 44118). Conservation status; land uses; uniqueness: Information not available. Imminent threats: Increased suburban sprawl is a threat to some of the fields but Holden Arboretum and Squire Valleevue Farm are protected reserves. Changes since last year: First year report. Danaus plexippus 3(S), Cercyonis pegala 54(N), Euptchia cymela 55(N), Phyciodes tharos 13(N), Nymphalis antiopa 1(S), Speyeria cybele 22(N), Satyrium acadica 5(N), Lycaena phlaeas 13(N), Colias philodice 94(N), Pieris rapae 85(N), Papilio polyxenes 1(N), P. glaucus 5(S), Hesperia sassacus 31(S), Epargyreus clarus 4 (N). Total 14 spp., about 386 indiv. Field notes: This was the first sighting of D. plexippus this year. One observer is very busy just counting!

ZONE 6: SOUTHEAST
(Florida, Louisiana, Mississippi, Virginia)

Reddish Knob, VA-WVA. 38°25'N, 79°13'W, center 3 mi SE Reddish Knob, includes portions of Pendleton Co., WVA and portions of Augusta, Highland and Rockingham Co., VA. Center moved SW from last year but areas counted last year are included. Elev: 389-1332 m. Habitat coverage: Clearings and abandoned pasture in shale barrens, agricultural fields, creeks, disturbed area near reservoir. 25 June 1980; 0800-1800 hrs; mostly cloudy all day; 16-21°C; wind variable, 0-8 km/hr. One observer in one party. Total party hours 7 (all on foot); total party miles 5. Observer: Paul A. Opler (Office of Endangered Species, US Fish and Wildlife Service, Washington, D.C. 20240). Conservation status; land uses: MOst of area within circle is part of George Washington Nat'l. Forest. Only a small amount of logging takes place in the area. Remainder is primarily small farms with varied grazing and farming. Excellent conservation status. Uniqueness: The most unique area is represented by the shale barrens habitats. The only known VA and WVA habitats of Phyciodes morpheis (referred to as P. sp. last year) lie within the count circle. Imminent threats: None. Changes since last year: None. Euptychia cymela 11(S), Lethe portlandia 4(S), Asterocampa celtis 1(S), Limenitis astyanax 29(C), L. archippus 1(S), Phciodes tharos 1(C), P."morpheis" 61(C), Chlosyne nycteis 10(photo), Eyphydryas phaeton 1(S), Vanessa virginiensis 4(S), Nymphalis antiopa 7(S), Speyeria cybele 23(S), S. aphrodite 13(S), S. atlantis 1(C), Bolloria bellona 4(S), Satyrium liparops 1(C), S. calanus 54(C), Strymon melinus 3(S), Lycaena phlaeus 1(S), Celastrina argiolus 30(S), Everes comyntas 65(S), Colias philodice 136(S), C. eurytheme 17(S), Pieris rapae 163 (S), Battus philenor 1(S), Papilio glaucus 1(S), P. troilus 5 (S), Euphyes vestris 3(S), Poanes hobomok 11(N), Hesperia sassacus 9(N), Wallengrenia egeremet 1(C), Polites origenenes 6(S), Thymelicus lineola 68(photo), Ancyloxypha numitor 5(S), Erynnis icelus 8(S), Thorybes bathyllus 1(photo), T. pylades 4(S), Epargyreus clarus 102(C). Total 38 spp., about 866 indiv. Field notes: Count conducted earlier in season but conditions were just as dry as on count day last year. Emergences seemed about one week early this year. T. lineola was incredibly abundant, only two were seen on six trips in 1979. Principle nectar sources were Echium vulgare, Apocynum cannabinum, A. androsaemifolium, Asclepias tuberosa, Crysanthemum leucanthemum, Trifolium pratense and T. repens.

Fort Belvoir, VA-MD. 38°41'N, 77°12'W, see 1978 report for site description. 23 June 1980; 0900-1800 hrs; clear all day; 27-34°C; wind W, 0-9 km/hr. Four observers in three parties. Total party hours 20 (all on foot); Total party miles 23. Observers: Mike Bentzien, John H. Fales, Paul A. Opler (office of Endangered Species, Washington, D.C. 20240), Tim Opler. Conservation status; land uses: Ownership of hayfield that was so productive last year has changed and the field is no longer mowed once a year. In a single year succession has been so rapid that butterfly diversity was strongly reduced. A new U.S. Army preserve was dedicated. Uniqueness: Fresh water marshes on Dogue Cr. and Rooster Run within or adjacent to Huntley Meadows County Park (1700 acres). Imminent threats: A new road (extension of Lockheed Blvd.) will go along one edge of Huntley Meadows Park and will probably eliminate several colonies of L. appalachia as well as increase local levels of air pollution. Several open areas have had new subdivisions built on them, but there remains a tremendous amt. of habitat. Danaus plexippus 5(S), Cercyonis pegala 5(S), Euptychia cymela 5(S), Lethe appalachia 25(S), Asterocampa celtis 1(S), Limenitis astyanax 3(S), Phyciodes tharos 131 (S), Polygonia interrogationis 1(S), P. comma 4(S), Vanessa atalanta 3(S), V. virginiensis 6(S), Nymphalis antiopa 14(S), Speyeria cybele 77(S), Harkenclenus titus 2(S), Satyrium liparops 4(N), S. calanus 86(S), Strymon melinus 10(S), Lycaena phlaeus 22(S), Celastrina argiolus 21(S), Everes comyntas 168 (S), Colias philodice 123(S), C. eurytheme 85(S), Pieris rapae72(S), Papilio polyxenes 2(S), P. glaucus 25(S), P. troilus 12(S), Graphium marcellus 4(S), Euphyes vestris 14(C), Poanes zabulon 15(C), Atrytone delaware 1(S), Pompeius verna 12(C), Wallengrenia otto 8(photo), W. egeremet 18(C), Polites coras 8(S), P. origenes 18(C), Ancyloxypha numitor 6(S), Nastra lherminier 26(C), Pholisora catullus 1(S), Erynnis horatius 6(S), Thorybes bathyllus 3(S), T. pylades 13(S), Achalarus lyciades 5(S), Epargyreus clarus 86(S). Total 43 spp., about 1157 indiv. Larvae seen: L. archippus 3 (on Salix sp.), V. atalanta 1 (on Boehmeria sp. (false nettle)). Field notes: Precount surveys had located several spp. which were not found during the count but were present in the preceeding two weeks, ie. E. m-album, I. niphon, C. cecrops, A. clyton, E. phaeton, T. lineola. On count day, most individuals were at flowers of the following plants: Asclepius syriaca, A. tuberosa, Rhus typhina, Apocynum cannabinum, Cephalanthus occidentalis, Trifolium repens. Emergences were about two weeks in advance of normal this year. The portion of the count circle in MD was covered for the first time this year. Mason Neck Wildlife Refuge was not covered, but a new preserve on Ft. Belvoir (U.S. Army) was included.

Lower East Pearl River, MS-LA. 30°21'N, 89°40'W. See 1977 report fro description. 12 July 1980; 0935-1538 hrs; clear in AM to mostly clear in PM; 30.5-36.7°C; wind nil. Three observers in one to three parties. Total party hours 6 (1.25 on foot, 4.75 by car); total party miles 130 (1 on foot, 129 by car). Observers: Frank Ehret, Jr., Lance Ehret, Frank P. Fischer, Jr. (2720 Octavia St., New Orleans, LA 70115). Conservation status, land uses; uniqueness; threats: See 1977 report. Changes since last year: None noted. Danaus plexippus 3(S), Cercyonis pegala 1(S), Limenitis astyanax 11(S,C), L. archippus 2(S), Precis coenia 4(S,C), Phyciodes tharos 16(S), Polygonia interrogationis 1(S), Vanessa atalanta 1(S), Agraulis vanillae 1(S), Colias philodice 2(S), Battus philenor 4(S,C), Papilio polyxenes 1(C), P. crestphontes 1(S,C), P. glaucus 7(S,C), P. troilus 4(S), P. palamedes 1(C), Hylephis phyleus 30(S,C), Erynnis zaruceo 2(C), Epargyreus clarus 3(S). Total 19 spp., about 95 indiv. Field notes: One of our best lanes had just been ditched so plants and flowers were nonexistent along the roadside. Temp. over 32° most of the day - ver hot! Our climate has been over 32° for 30 days prior to count with very little rain; flowers were in short supply; dust was excessive along roads. We were lucky to find 19 spp. this year.

Forman-Kleinpeter, LA. 30°22'N, 91°02'W, see 1977 report for further description. 6 July 1980; 1030-1600 hrs; clear oll day; 29.4-36.1°C; no wind. One observer in one party. Total party hours 5.5 (5 on foot, 0.5 by car); total party miles 11 (10 on foot, 1 by car). Observer: Michael L. Israel (1934 Oleander St. Baton Rouge, LA 70806). Conservation status; land uses; uniqueness; threats: See 1977 report. Changes since last year: None. Euptychia hermes sosybia 9(S), E. gemma 2(S), Lethe portlandia 2(S), Asterocampa celtis 9(S), A. clyton 1(S), Limenitis arthemis astyanax 1(S), L. archippus 8(S), Precis coenia 7(S), Phyciodes tharos 30(S), Polygonia interrogationis 2(S), P. comma 1(C), Vanessa atalanta 2(S), Euptoita claudia 3(S), Agraulis vanillae 4(S), Libytheana bachmannii 7(S), Strymon melinus 2(N), Colias eurytheme 1(S), Phoebus sennae 11(S), Battus philenor 1 Papilio polyxenes 2(C), P. crestphontes 2(S), P. glaucus 1(S), P. troilus 1(S), Euphyes vestris 3(N), Wallengria otto 1(N), Hylephila phyleus 23(S), Copaeodes minima 3(S), Lerema accius 1 (S), Pyrgus communis 20(S), Erynnis horatius 3(C), Epargyreus clarus 1(N). Total 31 spp., about 164 individuals.

W.J. Janes Memorial Drive, Copeland, FL. 26°03'N, 81°23'W, includes N. of Copeland along W.J. Janes Memorial Dr. (dirt road). Elev: 1.22-1.83 m. Habitat: 80% Big Cypress Swamp, 20% grass prairie-cypress, water oak, pine, palmettos, palms. 7 July 1980; 0900-1500 hrs; clear all day; 29-33°C; wind nil. Two observers in one party. Total party hours 6 (1 on foot, 5 by car); total party miles 13 (1 on foot). Observers: James C. Begg (Apt 1102, 710 N Ocean Blvd., Pompano Bch., FL 33062), Ada Ginsberg. Conservation status; land uses: Privately woned for hunting and fishing but under the jurisdiction of the State of Florida for environmental protection. Uniqueness: This area is in the Frakahatchee Strand, a swampy environment supporting many endangered flora and fauna. Imminent threats: None. Changes since last year: None. Danaus gillipus 22(S), Euptychis areolata 15 (S), Marpesia petreus 30(S), Limenitis archippus 200(S), Precis coenia 4(S), Anartia jatrophae 150(S), Phyciodes tharos 120(S), Heliconius charitonius 40(S), Agraulis vanillae 16(S), Calephelis virginiensis 7(S), Strymon melinus 1(S), Colias cesonia 1(S), Phoebis sennae euble 11(S), Eureme nicippe 1(S), Nathalis iole 1(N), Papilio polyxenes 6(S), P. glaucus 10(S), P. crestphontes 7(S), P. troilus 45(S), P. palamedes 75(S), Lerodea eufala 30(S,N), Euphyes arpa 1(N), E. palatka 1(N), Problema bulenta 1(N), Atalopedes campestris 1(N), Hesperia leonardus 1 (N), Ancyloxypha numitor 10(S), Pyrgus oileus 35(S), Erynnis horatius 3(S,N), Urabanus proteus 1(S). Total 30 spp., about 846 individuals.

San Mateo area, FL. 30°29'N, 81°29'W, center exactly between Shell Bluff Landing, Crescent Lk., Flagler Co. and San Mateo, Putnam Co. Elev: 0-25 m. Habitat coverage: Mature hickory/ live oak/cypress swamp. One of north Florida's most diverse habitats, with Gleditsia aquatica. 23 Jne 1980; 1100-1400 hrs; mostly clear in AM to partly cloudy in PM; 29-32°C; wind nil. At least thirty five observers in one party. Total party hours 3 (2 on foot, 1 by car); total party miles 12 (2 on foot). Observers: David Ahrenholtz, David Baggett (trip leader), David Bigelow, Daniel Bogar, Kathryn Boyd, John and Poody Brown, William Calvert, Charlie and Chuck Covell, Dennis Currett, Gaspar Danish, Quinby Hess, John Hyatt, Robert Parks, Floyd and June Preston, Dale Schweitzer, Mark Sitter, Thomas Sorri, Ray and Kit and Linda and Scott Stanford, Charles Watson. Also A.E. Brower, Ed Prescott and family, and others whose names we did not obtain. (Compiler: R.E. Stanford, 720 Fairfax St., Denver, CO 80220). Conservation status; and uses: Shell Bluff: recreational area with camping, fishing. San Mateo: rural area, residential, with orange groves and other cultivated crops. Uniqueness: See habitat coverage. Imminent threats: Logging is a potential threat to Shell Bluff; San Mateo is already disturbed (we collected in a vacant lot in town). Changes since last year: None in San Mateo. Much logging in Shell Bluff. Danaus plexippus 2(S), D. gilippus 1(S), Cercyonis pegala 1(S), Euptychia hermes 47(C), Asterocampa alicia 26(C), Limenitis archippus floridensis 5(C), Precis coenia 2(C), Phyciodes phaon 19(C), P. tharos 13(C), Vanessa atalanta 1(C), V. virginiensis 1(C), Euptoieta claudia 3(C), Heliconius charitonius 10 (C), Agraulis vanillae 11(C), Calycopis cecrops 3(C), Atlides halesus 1(C), Panthiades m-album 3(C), Strymon melinus 19(C), Hemiargus ceraunus 3(S), Phoebis sennae 1(S), Eurema daira 40(C), E. lisa 1(C), E. nicippe 5(S), Nathalis iole 2(C), Pieris protodice 4 (C), P. rapae 26(N), Ascia monuste 3(S), Battus polydamas 6(C), Papilio polyxenes 3(N), P. crestphontes 14(C), P. glaucus 7(C), P. troilus 9(C), P. palamedes 32(C), Graphium marcellus 2(C), Panoquina ocola 1(C), Atalopedes campestris 1(C), Wallengrenia otto 2(S), Polites themistocles 4(C), P. vibex 30(C), Hylephila phyleus 16(C), Copaeodes minima 3(C), Ancyloxypha numitor 2(C), Lerema accius 6(C), Nastra lherminier 1(C), Pyrgus oileus 5(C), Erynnis zarucco 3(larvae), E. horatius 4(C), Thorybes bathyllus 3(C), T. pylades 1(S), Urbanus proteus 10(C), Epargyreus clarus 6(C). Total 51 spp., about 424 indiv. Larvae seen: P. polyxenes 4 (on Angelica dentata), E. zarucco 3 (on Glottidium vesicarium) E. niccippe 5 (on Cassia obtusifolia). Field notes: This count was conducted during an official Lepidopterists' Society field trip following the 1980 meeting in Gainesville, FL. Two sites were visited and the expedition was led by Dave Baggett.

ZONE 7: NORTHEAST
(Connecticut, Maryland, Massachusetts, New York, Pennsylvania)

Clatter Valley, New Milford, CT. 41°28'N, 73°31'W, center at Girl Scout Camp, includes Clatter Valley Girl Scout Camp above Clatter Brook, to Lover's Leap on the Housatanic, and Wolf Pit Mtn. at New Milford town line. Elev: 610-915 m. Habitat coverage: Dry and wet meadow, pond edge, sandy banks. 8 July 1980; 1000-1500 hrs; mostly cloudy in AM to partly cloudy in PM; 17.7-27.7°C; wind NE, 3.2-16 km/hr. Sixty-five(!) observers in four parties. Total party hours 4 (all on foot); total party miles 3.25. Observers: Clara Ackerman, Kristina Albright Kim Arndt, Melissa Baine, Jennifer Bates, Sharon Bath, Rachel Bouley, Karyn Cass, Danielle Cavollo, Amy Casazza, Kristin Ciccone, Christine Cooper, Christine Cox, Shelly Crawford, Laurie David, Joan DeWind (Briggs Hill, Sherman, CT 06784), Jeanine Dlugorencky, Rene Dlugorencky, Jennifer Dugilio, Christy Dowd, Chrissy Dunn, Nina Filbert, Rachel Finch, Laurel Frolich, Andrea Foss, Sara Foster, Ellen Ginsburg, Jean Gileno, Sonya Hals, Shawn Hanlon, Michelle Hugar, Karen Jackubowski, Sandy Lane, Emily LePage, Christy Lipscomb, Kelly Lisi, Sara Lynn, Laurie Mayelle, Tracy Mayelle, Coleen McCormack, Jennifer Middletown, Lani Kim Moclair, Amy Moffie, Jennifer Norman, Diane Parese, Diane Reeves, Kristin Reppenhagen Mary Robb, Amy E. Scott, Marlene Schneider, Kristine Steinhebel, Debbie Tickell, Christy Van Deusen, Melissa Walker, Karen Walter, Willow Wheeler, Carolyn Wideau, Laura Wideau, Charlotte Woods, Merilee Woods, Lynn Worden. Conservation status; land uses: Girl Scout preserve. Uniqueness: None. Imminent threats: None. Changes since last year: First year count. Danaus plexippus 4(S), Cercyonis pegala 1(S), Euptychia cymela 1(S), Limenitia archippus 1(S), Euphydryas phaeton 1(S), Vanessa atalanta 1(S), Speyeria cybele 3(S), Boloria toddi 1(S), Colias philodice 11(N), C. eurytheme 10(N), Pieris rapae 125+(C), Papilio glaucus 5(S), Amblyscirtes vialis 1(C), Epargyreus clarus 9(N). Total 14 spp., about 174 indiv. Larvae seen: L. archippus 14 (on Salix sp.), D. plexippus 2 (on Asclepias sp.). Field notes: It was interesting to see that the counting improved so immediately for the few minutes we had warm sunshine. There are notable absences however, of Polygonia, Papilio, Phyciodes and hairstreaks.

Eliot Pratt Education Center, CT. 41°30'N, 73°28'W, center Eliot Pratt Educ. Ctr., New Milford. Habitat coverage: Dry meadows, gardens (vegetable), hedgerows, deciduous forest. 7 July 1980; 0945-1215 hrs; clear; 20-23.3°C; wind N to NE, 6.4 to 35 km/hr. Twentyfour observers in one to three parties. Total party hours 5.75 (all on foot); total party miles 5.75. Observers: Karen Baumgardner, Sharon Brown, Lisa Curesky, Joan DeWind (Briggs Hill, Sherman, CT 06784), Zoey Friedman, Kevin Garnett, Lee Garnett, Vicky Gitterman, Joey Golaszewski, Paul Golaszewski, Dana Hirsch, Mike Jalensffy, John Klein, Thomas Neufeld, Christopher Padow, Dolly Patterson, David Regan, Kendall Rostenberg, Jeff Simpson, Elizabeth Sinclair, Laura Sinclair, Marylee Sinclair, Sara Sinclair, E. Woods Sinclair. Conservation status; land uses: Private reserve. Uniqueness of habitat: None. Imminent threats: None. Changes since last year: Variations in the pattern of mowing of hayfields. Danaus plexippus 1(S), Cercyonis pegala 1(S), Speyeria cybele 5(C), Boloria selene 2(C), B. toddi 2(C), Colias philodice 5 (N), C. eurytheme 6(N), Pieris rapae 150(C), Papilio glaucus 1(S), Thymelicus lineola 14(C), Ancyloxypha numitor 2(N). Total 11 spp., about 290 individuals. Field notes: The preceding night was very cold, about 6°C and there was considerable wind, making the outlook for butterflies doubtful (as proved true by the count results).

Greenwich Audubon Center, CT. 41°04'N, 73°41'W. See earlier reports for description. Habitat coverage: Old field, deciduous forest (primarily beech, maple, birch). 19 July 1980; 1030-1230 hrs; clear; 28°C; winds not reported. Seven observers in one to two parties. Total party hours 2 (all on foot); total party miles 4. Observers: Heather Battaly, Trudy Battaly, Macky Bennet, Rick Millette, Drew Panko, Laura Panko, Sandy Russell (Orchard St., Greenwich, CT). Conservation status; land uses: Wildlife sanctuary. Imminent threats: None. Changes since last year: None. Danaus plexippus 1(S), Cercyonis pegala 25(S), Euptychia cymela 1(S), Phyciodes tharos 4 (N), Nymphalis anitopa 5(S), Satyrium liparops 1(N), S. calanus 5(N), S. edwardsii 1(N), Speyeria cybele 31(N), Lycaena phlaeas 15(N), Colias philodice 3(S), C. eurytheme 1(S), Pieris rapae 80(S), Battus philenor 2(S), Papilio glaucus 7 (S), Ancyloxypha numitor 14(S), Epargyreus clarus 2(S). Total 17 spp., about 198 individuals.

Sherman, CT. 41°51'N, 73°30'W, center Xerces Soc. Secretarial office, includes DeWind and Piel fields, Graeter-Beardslee Gardens, Town Meadows and Garage, Inc., Naromi Brook and Swamp, Carlson Farm. Elev: 27-400 m. Habitat coverage: wet and dry fields, mown and unmown; forest; edges; flower gardens; sand and gravel pits, some swamp. 9 July 1980; 1030-1430 hrs; mostly clear with haze all day; 28.9-31.6°C; wind S, SW, 0-6 km/hr. Six observers in one to three parties. Total party hours 10 (9 on foot, 1 by car); total party miles 11 (3 on foot, 8 by car). Observers: Francine Carlie, Miriam Chapman, Joan DeWind (Friggs Hiss, Sherman, CT 06784), Debbie Hopkins, Baxter Patrick, Irene Weddell. Conservation status; land uses; imminent threats: The former gravel pit and old farm land along the Housatanic is now being fought over for development. It has more wild flowers than any other similar size parcel in Sherman. Changes since last year: Naromi Brook land is gradually becoming overgrown. Danaus plexippus 1(S), Cercyonis pegala alope 5(S,C), Limenitis arthemis astyanax 1 (S), L. archippus 1(S), Phyciodes tharos 1(S), Polygonia comma 1(S), Vanessa atalanta 1(S), Nymphalis vau-album 1(S), N. antiopa 10(S), Speyeria cybele 2(S), S. atlantis 1(S), Boloria toddi 1(S), Harkenclenus titus 1(N), Satyrium calanus 9(S,C,N) S. caryaevorum 3(C), S. acadica 2(S,C), Everes comyntas 2(S), Colias philodice 3(S,C), C. eurytheme 2(S), Pieris rapae 6(S), Papilio glaucus 1(S), Hesperia ottoe 1(C), Wallengrenia egeremet 2(C), Polites themistocles 3(S,C), Ancyloxypha numitor 3(S,C), Pholisora catullus 2(S,C), Epargyreus clarus 5(S,C). Total 27 spp., about 72 indiv. Larvae seen: V. atalanta 1 (on Urtica sp.), P. interrogationis 1 (on Urtica sp.), D. plexippus 1 (on Asclepias sp.).

White Memorial Conservation Center, CT. 41°45'N, 73°15'W, center at White Mem. Center Museum, includes White Flower farm, nursery and display area, perennial growing area, T.J. Camp fields, roads from Farm to Center, RR crossing and bog. Elev: 926-1197 m. Habitat coverage: 12.5% commercial nursery; 25% growing area; 25% old field, wet and dry (unmowed 2 yrs.; 25% old RR bog; 12.5% roads, flowered margins. 6 July 1980; 1015-1530 hrs; clear all day; 20-23.3°C; wind N, NE, 8-35 km/hr. Seven observers in two to three parties. Total party hours 7 (6.5 on foot, 0.5 by car); total party miles 11.5 (2.5 on foot, 9 by car). Observers: Helene Dautrich, Gelicia DeLagerac, Joan DeWind (Briggs Hill, Sherman, CT 06784), Josh DeWind, Alfred Uhry, Jolly Uhry. Conservation status; land use: Commercial flower area. Uniqueness of habitat: RR tracks and acid swamp. Imminent threats: Succession in old fields, beavers. Changes since last year: Flower area expanded increasing nectaring sources. Planting of evergreens and hiatus of mowing in adjoining fields reducing wildflower population. Danaus plexippus 1(S), Cercyonis pegala 2(S), Lethe eurydice 2(C), Nymphalis antiopa 1(S), Satyrium calanus 7(C), Speyeria cybele 2(S), Limenitis astyanax 1(S), Everes comyntas 2(C), Colias philodice 7(N), C. eurytheme 2(S), Pieris rapae 27(S), Thymelicus lineola 100+(C), Ancyloxypha numitor3(N). Total 14 spp., about 300 indiv. Larvae seen: L. archippus 4 (on Salix sp.). Field notes: This was a miserable day to count. There had been about three inches of rain the day before, followed by high, gusting winds which lowered the temperature a great deal.

Barnstable, MA. 41°37'N, 70°33'W, includes area from Woods Hole N to Falmouth, E to Mashpee and S to Cotuit. Elev: 1-30 m. Habitat coverage: See field notes. 5 July 1980; 1000-1600 hrs; clear all day; 27-33°C; wind variable, 0-5 km/hr. Three observers in one party. Total party hours 5.6 (all on foot); total party miles 7. Observers: Dr. Robert L. Edwards (Box 505, Woods Hole, MA, 02543), Eric H. Edwards, Rebecca Lash. Conservation status; land uses: Mostly controlled against significant change. Uniqueness: The four principle sites covered all typical habitats except undisturbed bogs and built up areas. Imminent threats: Urbanization in a minimal way. Spraying for Porthetria dispar (gypsy moth). Changes since last year. None. Danaus plexippus 9(S), Cercyonis pegala 1 (S), Euptychia cymela 5(S,C), Limenitis arthemis 1(C), Phyciodes tharos 1(S), Vanessa virginiensis 1(N), Lycaena epixanthe 61(S,C), L. phlaeas 2(S), Everes comyntas 8S(,N), Colias philodice 7(S), Pieris rapae 65(S), Papilio glaucus 2(C) P. troilus 19(S,C), Poanes hobomok 7(S,C), Atrytone delaware 2(C), Polites themistocles 11(S,C), P. mystic 1(C), Adopaea lineola 135(S,C). Total 21 spp., about 405 indiv. Larvae seen D. plexippus 1 (on Asclepius sp.). Field notes: The startingly different spp. composition this year might be a consequence of many factors including an unusually mild winter and wide spread gypsy moth control efforts (spraying). In Falmouth, habitat was mixed hardwood-pine; a site with old fields succeeding to shrubs (maintained for rabbits, quail, etc.); Hatchville - an active cranberry bog surrounded by hardwoods with an old field at one end.

Clymer Bog, Chautauqua Co., NY. Includes Clymer Bog and the immediate periphery. Elev: 475 m. Habitat coverage: A bog (95%) surrounded by hayfields with thornapple bushes (5%). 4 July 1980; 1100-1300 hrs; clear all day; 26.7°C; Wind SW, 0-8 km/hr. Two observers in one party. Total party hours 4 (on foot). Observers: Theodore N. Taft (223 Seymore St., Fredonia, NY 14063), Theodore N. Taft, Jr. Conservation status; land uses: Private lands used for agriculture. Uniqueness: True xerothermic sphagnum bog, 330x160 m. yet supports unusually large colony of L. epixanthe. Imminent threats: Agricultural runoff, invasion of bog by introduced skipper, T. lineola which feeds on Eriphorum truellum, a cottongrass sedge. Changes since last year: Increasing numbers of T. lineola. Vanessa virginiensis 1(N), Speyeria cybele 1(N), Boloria bellona 3(N), Lycaena epixanthe 100+(N), Colias philodice 10(N), C. eurytheme 50(N), Thymelicus lineola 200+ (N). Total 7 spp., about 365+ indiv. Field notes: The Clymer Bog is very unique and should be preserved. Its small size may be it's best assurance to preservation as it sould seem uneconomical to drain or otherwise cause it's demise. The bog's flora includes: Eriophorum teyellum, Drosera totoundifolia, Sarracena porporea, Chamaedaphae calyculata, Vaccinium oxycoccus.

Inwood Hill Park, Manhattan, NY. 40°52'N, 73°55'W, center Inwood Hill Park, includes E to Broadway, N to Spuyten Duyvil Creek (AKA Harlem River), W to Hudson River, S to Dyckman St. Elev: 0-70.15 m. Habitat coverage: 85% oak, hickory, tulip, catalpa trees, fruitwoods, hackberry thickets; 15% moist meadow with small sassafrass and locust. 27 June 1980; 1100-1945; clear all day; 26-32°C; wind NE, 0-16 km/hr. One observer. Total party hours 8.75 (on foot); total party miles 4. Observer: Jeffrey S. Ingraham (55 8th Ave., Brooklyn, NY 11217). Conservation status; land uses: Because there are so few parks on Manhattan, this area is well protected from developers although the Henry Hudson Pkwy. cuts through a portion of it. Uniqueness: Last remaining original flora on Manhattan. Imminent threats to habitats and entomologists with butterfly nets: Small roving gangs of tough guys from the Bronx sometimes carrying bats, chair legs, pipes and concealed weapons. They usually stay on the trails. No motor vehicle allowed. Changes since last year: First year count. Danaus plexippus 4(C)*, Euptychia cymela 24+, Asterocampa celtis 4, Phyciodes tharos 3, Polygonia interrogationis 13+, P. comma 4, Vanessa atalanta 9, V. virginiensis 2, Nymphalis antiopa 18+, Chlosyne nycteis 9, Satyrium liparops 2, S. calanus abundant, S. caryaevorus abundant, Celastrina argiolus 18+, Everes comyntas 6, Colias philodice 7, C. eurytheme 21+, Pieris rapae abundant, Papilio polyxenes 2, P. glaucus 64+, P. troilus 3, Poanes zabulon 17+, P. hobomok 31+, Pompeis verna 37+, Thymelicus lineola 34+, Thorybes pylades 2, Achalarus lyciades 32+, Ancyloxypha numitor 13, Epargyreus clarus 32+. Total 34 spp., about 1000 indiv. Larvae seen: D. plexippus 2 (on Asclepius sp.). Field notes: Having collected in both Prospect Park, Brooklyn, and Central Park, Manhattan

with little success, I was quite surprised by the abundance of butterflies at Inwood Hill Park, with some rare species like A. celtis and C. nycteis. This area is the northernmost tip of Manhattan and faces Palisades Park, NJ, the Harlem River and Kings Bridge Hgts. in the Bronx. Unlike Prospect Pk. and Central Pk. which were landscaped and replanted by Frederick Olmstead in the 19th century, Inwood remains almost untouched by man's activities and is representative of what Manhattan Island used to look like in the early 1600's. (no documentation was provided for this statement - ed.) Ft. Tryon Pk. and The Cloisters just to the S are neatly landscaped and manicured with far fewer butterflies to observe. *All butterflies identified by collection however that represented only a small percentage of the numbers indicated here. (ed.)

Inwood Hill Park, NY. 40°46'N, 73°58'W, includes Inwood Hill Pk., Central Pk., Van Cortlandt Pk., Bronx Pk., Pelham Bay Pk. Elev: 0-67 m. Habitat coverage: Lawns, meadows, wet woodland with poplar and tulip trees, dry woodland with oak and ash trees. 21 and 30 June 1980; 1400-1800 hrs; 26-30°C; wind W, 0-16 km/hr. Six observers in one party. Total party miles 20 (by car). Observers: E. Barlow, J. Hamilton, D. Monk, L. Pohner (345 E.83 Str., NY, NY 10028), E. Thompson, R. Vance. Conservation status; land uses: All sites are multi-use city parks which includes woodlands and recreational areas. Uniqueness: Areas are unremarkable. Imminent threats: None. Changes since last year: Ash and black cherry have died. Danaus plexippus 6*, Euptychia cymela 15, Asterocampa celtis 3, Chlosyne necteis 1, Polygonia interrogationis 1, P. comma 1, Vanessa atalanta 1, Nymphalis antiopa 17, Celastrina argiolus 11, Colias philodice 16, C. eurytheme 8, Pieris rapae 99, Papilio glaucus 20, P. troilus 3, Poanes hobomok 7, Ancyloxypha numitor 14, Achalarus lyciades 1, Epargyreus clarus 11. Total 18 spp., about 244 indiv. (*All ID's by sight.)

Beaver Meadow Envr. Educ. Center, NY. Center at intersection Welch Rd. and the tracks of A&A RR in Wyoming Co. Elev: 1700 m. Habitat coverage: Roadsides, fields and edges. 28 June 1980; 0900-1200 hrs; intermittent drizzle in AM to intermittent rain in PM; 13-21°C; wind nil. Eight observers in one party. Total party hours 3 (on foot); total party miles 1. Observers: Esther Becker, Taddy Dann, Marty Dessert, Lois Donovan, David Junkin (Welch Rd., North Java, NY 14113), John Riggs, Gretchen Shore, Ree Thayer. Conservation status; land uses: Last farmed in 1969, fallow since then. Beaver Meadow is a 267 acre preserve. Uniqueness: No unique habitats. Imminent threats: None. Changes since last year: No data. Danaus plexippus 1(S), Euptychia cymela 1(S), Limenitis arthemis 1 (S), Phyciodes tharos 2(C), Nymphalis antiopa 1(S), Celastrina argiolus 1(S), Colias eurytheme 3(S), Papilio polyxenes 1(S), P. glaucus 1(S), Ancyloxypha numitor 500(S), Epargyreus clarus 1(S). Total 11 spp., about 513 individuals.

Calvert Co., MD. 35°37'N, 76°39'W. See 1976 report for further description of habitat. 13 July 1980; 0900-1724; clear all day; 25-30°C; wind E, SE, 0-10 km/hr. Two observers in two parties. Total party hours 15 (9.8 on foot, 5.2 by car); total party miles 93 (8 on foot, 85 by car). Observers: John H. Fales (2809 Ridge Rd., Neeld Estate, Huntington, MD 20639) Paul A. Opler. Conservation status; land uses; uniqueness: see previous reports. Imminent threats: Housing developments. Changes since last year: None. Danaus plexippus 17(S) (all following ID's by sight unless otherwise noted) Cercyonis pegala 1, Euptychia cymela 3, Lethe appalachia 1, Limenitis astyanax 17, L. archippus 9, Precis coenia 8(C), Phyciodes tharos 38, Polygonia interrogationis 3, P. comma 5, Vanessa atalanta 5, V. cardui 1, V. virginiensis 28, Nymphalis antiopa 2, Euptoieta claudia 5(C), Speyeria cybele 22, Callophrys gryneus 19(C), Strymon melinus 7, Celastrina argiolus 5, Everes comyntas 68(C), Colias philodice 68, C. eurytheme 62, Pieris rapae 360, Papilio polyxenes 5, P. glaucus 56, P. troilus 9, Graphium marcellus 20, Poanes viator 12, Atalopedes campestris 360, Hylephila phyleus 1(C), Ancyloxypha numitor 428, Pholisora catullus 23, Erynnis horatius 20(C), Epargyreus clarus 84. Total 34 spp., about 1777 individuals. Field notes: Nectar sources included Asclepias sp., Buttonbush, Queen Anne's Lace, Sweet Clover, Red Clover.

Pool Wildlife Sanctuary, PA. 40°32.5'N, 75°32.5'W, center Pool Wildlife Sanctuary, 601 Orchid Pl., Emmaus, PA 18049, includes area within Rt. 29 to the W, Little Lehigh Cr. to the S and E, Lehigh Country Club to the N. Elev: 97-122 m. Habitat coverage: 60% meadow, 20% edge, 15% deciduous woodland, 5% river. 28 June 1980; 100-1200 hrs; clear; 25-30°C; wind SE, 3-6 km/hr. Ten observers in ten to one party. Total party hours 2 (all on foot); total party miles 1. Observers: Dr. and Mrs. Carl Brunner and daughter, Keith Butler (Lehigh Valley Conservancy, Inc., 1024 W. Broad St., Bethlehelm, PA 18018), Linda Van Emburg, Philip Klotz, Bob Rittershofer, Mr. Rehai, Jonathon Rekai, Mary Rekai, Mary Beth Danko. Conservation status; land uses: Wildlife habitat, environmental deucation. Uniqueness: None. Imminent threats: Succession and river run off. Changes since last year: Increased number of species observed. Limenitis archippus 1(S), Phyciodes tharos 2(N), Nymphalis antiopa 2(S), Boloria bellona 1(N), Satyrium calanus 12(N), Colias philodice 5(S), Pieris rapae 88(S), Papilio polyxenes 1(S), P. troilus 1(S), Polites verna 2(N), Wallengrenia otto 6(N), Thymelicus lineola 22(N), Ancyloxypha numitor 8(N). Total 13 spp., about 151 indiv.

Union City, PA. 41°53'N, 79°53'W, center at foot of Oak Hill at jct. Wheelertown Rd. and Rt. 92. See earlier reports for further descriptions. 6 July 1980; 1030-1830 hrs; partly cloudy in AM to clear in PM; 20-25°C; wind NE, 16-32 km/hr. Two observers in one party. Total party hours 8 (6.5 on foot, 1.5 by car); total party miles 18 (5 on foot). Observers: Gerald M. McWilliams (1 O'Dell St., Union City, PA 16438), Sam Stull. Conservation status; land uses; uniqueness: See earlier reports. No changes noticed since last year. Danaus plexippus 5(S), Cercyonis pegala 9(S), Euptychia cymela 2(S), Lethe appalachia 2(N), Limenitis archippus 7(S), Phyciodes tharos 8(S), Polygonia interrogationis 1(S), Vanessa atalanta 5(S), Nymphalis antiopa 3(S), Speyeria cybele 17(S,N), S. aphrodite 2(N), Boloria bellona 33(S,N), Harkenclenus titus 13(S), Satyrium liparops 1(S), S. a. acadica 14(S), Celastrina argiolus 3(S), Colias philodice 50(S), C. eurytheme 40(S), Pieris rapae 100+(S), Papilio glaucus 2(S), Euphyes vestris 15(S,N), Poanes hobomok 3(S), Wallengrenia egeremet 6(N), Polites coras 3(S), P. themistocles 3(N), P. origenenes 1(N), Thymelicus lineola 1000+(S), Ancyloxypha numitor 4(S), Erynnis juvenalis 1(C), Epargyreus clarus 3(S). Total 28 spp. about 1376+ individuals.

Lower Bucks Co., PA. 42°02'N, 75°W. See earlier reports for further descriptions. Habitat coverage: Swamps, park meadows, residential. 5 July 1980; 1000-1515 hrs; mostly clear in AM to partly cloudy in PM; 30-32°C; wind N to NW, 16-24 km/hr. Two observers in one party. Total party hours 10 (8 on foot, 2 by car); total party miles not reported. Observers: Wynne Epstein, Frances Naas (9 Harding Ave., Feasterville, PA 19047). Uses of land: Parks, roadsides. Danaus plexippus 3 (S), Limenitis arthemis 2(S), Phyciodes tharos 7(N), Speyeria cybele 20(S), Boloria toddi 1(N), Satyrium liparops 5(N), Colias philodice 4(S), Pieris rapae 6(S), Papilio glaucus 4 (S), Epargyreus clarus 6(N). Total 10 spp., about 58 indiv. Larvae seen: D. plexippus 20 (on Asclepias sp.), P. polyxenes 8 (on Daucus caeota). Field notes: Population decrease of Boloria. Favored field is mowed in mid July. Calls and letters have been sent.

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Count results are reported in the following order of data:

1. Name of count area, county and state.
2. Precise (latitude, longitude) and descriptive location of count center. Count area is a circle 15 miles in diameter.
3. Sites included within the count circle.
4. Types and amounts of each habitat within the count circle.
5. Date and time of count.
6. Climatic conditions.
7. Number of participants.
8. Total time spent by count party on foot or by car.
9. Total distance covered by count party on foot or by car.
10. Names of participants; address for compiler.
11. Conservation status of count area; Land uses; Uniqueness of habitats within the count circle.
12. Changes noticed in the habitat since last count.
13. Recorded butterfly species.
    Key to abundance abbreviations:
    A) Numbers refer to numbers of individuals seen.
    B) Method of identification:
        S - sighted
        N - netted and released
        C - collected (vouchers)

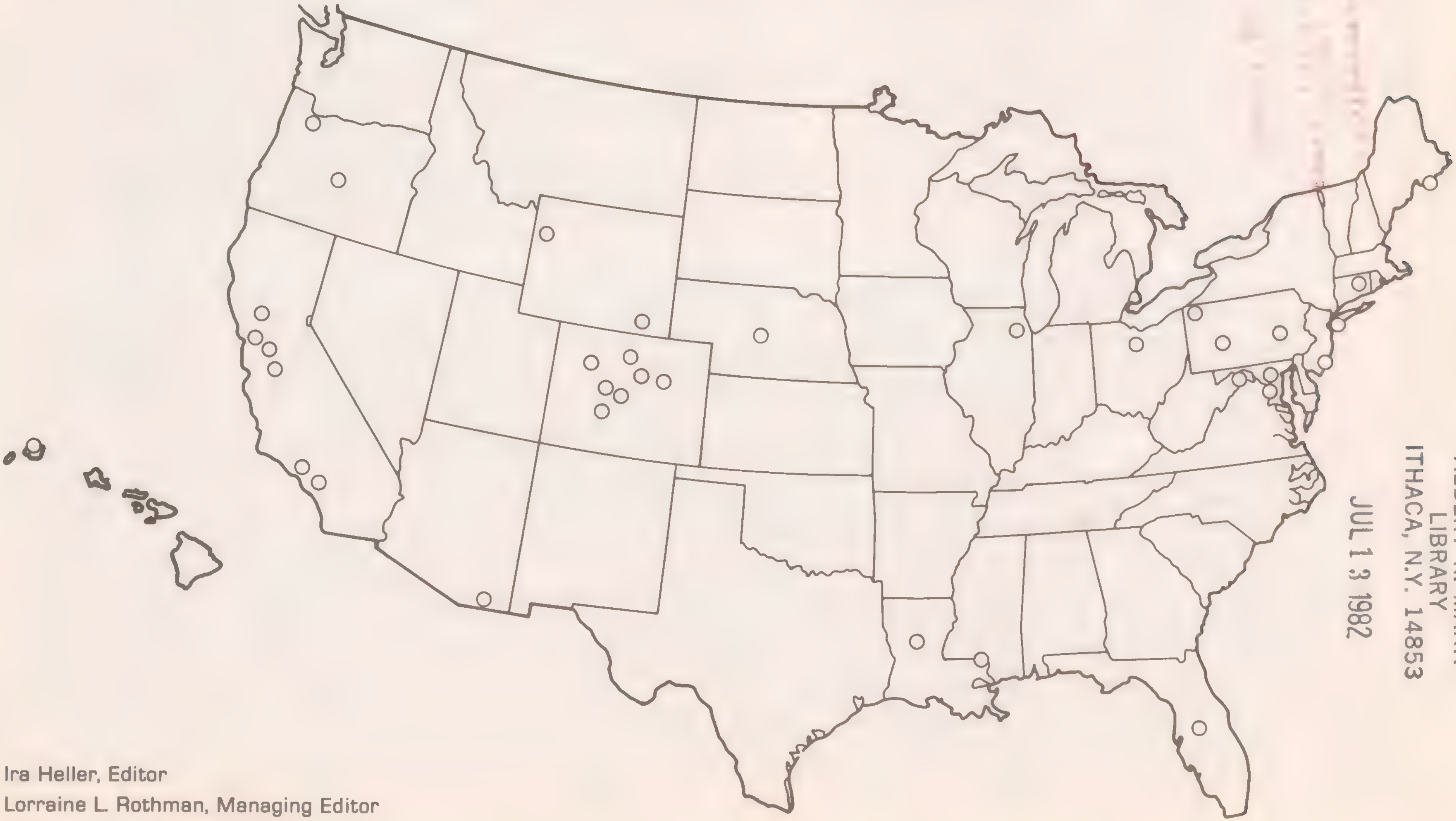
FOR FURTHER INFORMATION ON THE FOURTH OF JULY BUTTERFLY COUNT, PLEASE CONTACT: Ira Heller, Department of Biology, Tufts University, Medford, MA 02155, USA.

THE FOURTH OF JULY BUTTERFLY COUNT IS ORGANIZED AND SPONSORED BY THE XERCES SOCIETY, AN INTERNATIONAL ORGANIZATION DEVOTED TO HABITAT PROTECTION FOR RARE & ENDANGERED TERRESTRIAL ARTHROPODS (ESPECIALLY BUTTERFLIES) AND TO ENHANCING AN APPRECIATION OF THE BENEFICIAL ROLES INSECTS PLAY IN NATURAL ECOSYSTEMS. FOR FURTHER INFORMATION ON THE SOCIETY, PLEASE CONTACT: Terry Clifford, Secretary, Department of Zoology & Physiology, University of Wyoming, Laramie, WY 82071, USA.

ATALA SUPPLEMENT

Volume 8 1980(82)

1981 BUTTERFLY COUNT RESULTS



Ira Heller, Editor
Lorraine L. Rothman, Managing Editor

FOURTH OF JULY BUTTERFLY COUNT 1981 RESULTS

1981 FOURTH OF JULY BUTTERFLY COUNT

Ira Heller, Editor

The Fourth of July Butterfly Count for 1981 covered the period 20 June through 12 July. There were 44 counts reported, involving 260 participants distributed among 20 states. Colorado and California were best represented with 9 and 5 counts respectively.

Numbers of species observed ranged from 4 (Portland, OR) to 65 (Ramsey Cyn, AZ) to 97 (Gilpin Co., Lower Circle, CO) and averaged 32.8 species per count. The number of individual butterflies tallied per count ranged from 18 (UCLA campus, CA) to 2588 (Berkeley, CA), averaging 748.3 specimens per count. Numbers of participants ranged from 1 (6 counts) to 34 (Adams County Preserves, OH) and averaged 5.9 participants per count. 44 counts were conducted this year. 37 (84%) represented continued coverage of a count zone while 7 (16%) were reported from new sites.

ZONE 1: SOUTHWEST
(Arizona, California)

Ramsey Canyon, AZ. 26°10'N, 112°20'W, center 2.5 mi ESE Nicksville, AZ, includes eastern flank of Huachuca Mts. north to Brown Cyn, S to Coronado Nat'l Monument, E to the San Pedro River, N to 2 mi S of Sierra Visa, AZ. Elev: 1280-2800 m. Habitat coverage: 50% oak woodland; 20% riparian; 10% pine-oak forest; 10% farmland; 10% mesquite grassland. 19 July 1981 0700-1600 hrs; partly cloudy in AM to mostly clear in PM; 19-32°C; wind nil. Eight observers in four parties. Total party hours 27 (18 on foot, 9 by car); total party miles 70 (12 on foot). Observers: Richard Bailowitz, Jeff Burne, Doug Danforth (Box 232, Bisbee, AZ 85603), Bee Moorhouse, Arnold Moorhouse, Doug Mullins, Carl Olson, Killian Roever. Conservation status; land uses; uniqueness; imminent threats: See 1980 report. Changes since last year: Newly cultivated alfalfa fields. Danaus plexippus 11(**), D. gillipus 28, Euptychia rubricata 50(C), Asterocampa montis 3(N), Adelpha bredowii 22, Limenitis archippus obsoleta 5, L. astyanax 13, Precis coenia 1, Phyciodes picta 1, P. mylitta 1, Texola elada 2(N), Chlosyne lacinia 8, C. theona 1, Polygonia satyrus 3, Vanessa atalanta 2, V. cardui 5, V. virginienses 9, Nymphalis antiopa 5, Euptoieta claudia 6, Emesis zela 7, Hypaurotis crysalis 1, Callophrys siva 2, Ministrymon leda 2, Atlides halesus 1, Strymon melinus 3, Erora quaderna 1(C), Brephidium exilis 5, Leptotes marina 30, Hemiargus isola 1, Celastrina argiolus 6, Everes amyntula 2(C), Colias eurytheme 1009, C. cessonia 3, Phoebis sennae 112 Eurema nicippe 8, Nathalis iole 5, Pieris protodice 38, P. rapae 1, Battus philenor 89, Papilio polyxenes 1, P. multicaudatus 18, Megathymus ursus 1, Amblyscirtes exoteria 2, A. cassus 1, A. aenus 14, Atrytonopsis lunas 2, Poanes taxiles 43 Hylephila phyleus 2, Copaeodes aurantiaca 9, Oarisma edwarsii 1, Lerema accius 1(C), Pholisora catullus 10(N), Pyrgus communis 23, Erynnis juvenalis clitus 2(N), E. tristis taitus 11 (N), E. pacuvius 2(N), E. funeralis 2, Staphylus ceos 6, Cogia hippalus 12(N), C. caicus moschus 3(N), Thorybes pylades 14, Autochton cellus 1, Epargyreus clarus 1, Pyrrhopyge araxes 5. Total 65 spp., about 1721 indiv. Larvae seen: E. clarus 1 (on New Mexico Locust), Agathymus aryxma 1 (on Manfreda sp.), A. evansi 1 (on Manfreda sp. (Agave)). Field notes: Although the rainy season had started on schedule this year, drought conditions prevailed during the two preceeding years. Numbers of some common species were way down from previous years and some species were just not found despite excellent coverage. For example: (The species numbers are listed in order for the years 1979, 1980, 1981) A. cassus 30,19, 1; P. taxiles 118, 118, 43; A. fimbriata 27,13,0; E. mexicana 114,30,7; E. nicippe 81,30,8; L. marino 194, 1515,30; C. henshawi 4,15,0. (**Denotes species identified by sight, unless otherwise noted.)

Berkeley, CA. See 1975 report for complete count area description. 27 June 1981; 0935-1710 hrs; 17-34°C; wind W, NW, variable. Fifteen observers in eight to ten parties. Total party hours 44.75 (43.75 on foot, 1 by car); total party miles 116.25 (61.25 on foot, 55 by car, not observing). Observers: V. Brown, M. Buegler, J. DeBenedictis, G. Frankie, J. Frankie, R. Kelson, V. Lewis, L. Lewis, S. Meredith, M. Minno, D. Powell, J. Powell (201 Wellman Hall, Univ. of California, Berkeley, CA 94720), K. Smith, D. Wagner, J. Washburn. Conservation status; land uses: Wildcat, Tilden and Redwood Regional Parks; Russell Natural Land and Water Reserve (UC); Strawberry Cyn ecological study are and Botanical Garden (UC); Briones Reservoir (East Bay Municipal Water District); Berkeley Rose Garden (city). Uniqueness; Imminent threats: See 1975 report. Changes since last year: None. Danaus plexippus 6(S), Cercyonis pegala 168(S,C), C. silvestris 6(S,C), Coenonympha california 45(S), Adelpha bredowi 38(S), Limenitis lorquini 6(S,N), Precis coenia 178(S), Phyciodes mylitta 67 (S,N), Euphydryas chalcedona 14(S,N), Polygonia satyrus 18 (S,C), P. oreas 4(C), Vanessa atalanta 44(S), V. cardui 2(S), V. virginiensis 19(S,N), V. annabella 39(S,N), Nymphalis antiopa 10(S), Speyeria coronis 1(C), Agraulis vanillae 23(S), Habrodais grunus 20(S,C), Satyrium sylvinus 3(C), Callophrys augustinus 1(C), Strymon melinus 33(S,C), Lycaena arota 8(S, C), L. gorgon 12(S,C), L. xanthoides 62(S,C), L. helloides 9 (S,C), Euphilotes enoptes 1(C), Celastrina argiolus echo 20 (S,C), Plebejus acmon 231(S,N), Colias eurytheme 17(S), Pieris napi 2(C), P. rapae 691(S,N), Euchloe ausonides 5(S,C), Battus philenor 71(S), Papilio zelicaon 23(S), P. rutulus 40 (S), P. eurymedon 4(S), Paratrytone melane 28(S), Ochlodes sylvanoides 3(C), O. agricola 72(S,N), Atalopedes campestris 2(C), Polites sabuleti 99(S,N), Hylephila phyleus 96(S,N), Pyrgus communis 110(S,N), Erynnis tristis 11(S). Total 46 spp., about 2588 indiv. Larvae seen: V. atalanta 1 (on Urtica holosericea); V. virginiensis 2 (on Gnaphalium sp); B. philenor 80 (on Aristolochia californica). Pupae seen: Battus philenor 2 (on unrelated plants). Field notes: A mild, dry winter (65-75% normal rainfall) resulted in little species turnover. M. palla, S. callippe and A. sara were the only absentees among usually seen species. Spring butterflies were fewer, notably P. eurymedon (12% of its 1980 total), E. ausonides (14%) and E. chalcedona (5%), but these declines were more than offset by early buildup of homodynamic species, e.g., P. acmon (312%), the Vanessa-Precis group (194%) and city Hesperiinae (312%). Three urban parties averaged 56.3 butterflies/ party hr while counting 17, 14 and 11 species, a substantial increase in abundance but decrease in diversity compared to 1980. Rural parties, by contrast, showed only slight decrease in species and an increase in abundance, counting 32, 29, 28 and 26 and averaging 58.5 butterflies/ hr. Overall abundance (57.6 individuals / hr) was 135% that of 1980, a closer to normal rainfall year, but still substantially lower than in 1979. The increase may be attributable to early buildup of homodynamic species and summer species such as C. pegala (284% of 1980 total). P. rapae and P. acmon alone added 418 individuals. C. silvestris was the only spp. not observed in any of the 6 previous counts (a new record for the Berkeley Hills), possibly also the result of early emergence by a summer species. The Redwood Cyn-Skyline area produced 29 spp., Tilden Park-Wildcat Cyn 26 and the recently opened Regional Park Trail in Fish Ranch Cyn, 21.

Kern River Valley, CA. 39°20'N, 118°28'W, center 3.5 mi NNW of Lake Isabella, includes Lake Isabella, N to Kernville, E to Weldon and Kern River Preserve, S to Bodfish Pk, W to Greenhorn Mts and Shirley Pk and Shirley Mdws. Also Erskine Cr and Keysville. Elev: 686-2266 m. Habitat coverage: 35% cottonwood/willow forest; 25% pine/fir forest; 15% alkalai meadows (salt grass and Anemopsis); 10% sycamore/walnut creek bottom, 8% evergreen/oak hillsides; 7% wet meadows. 11 July 1981; 0700-1800 hrs; clear all day; 13-34°C; wind W, slight. Four observers in one party. Total party hours 10 (7 on foot, 3 by car); total party miles 50 (4 on foot, 56 by car). Ob-

servers: Rick Hewett (PO Box 1662, Weldon, CA 93283), Diana Jones, Phil Nordin, Roy Shaw. Conservation status, land uses: Private, US Forest Svc, Federal Gov't., ranching, residential, recreational. Eastern section of area protected by Army Corps of Engineers and The Nature Conservancy. Uniqueness: Alkalai meadows with Pseudocopaeodes eunus present; wet meadows with Speyeria hydaspe viridicornis; Atriplex sp. lined ditches with healthy population of Plebejus emigdionis. Imminent threats: Limited development is slated for the residential areas. Recreational use of forest and Army Corps lands will probably increase, especially along public roadways and campgrounds. Periodic flooding of 60 acres of prime riparian forest of Army Corps land at E end of Isabella Reservoir. Changes since last year: First year report. Danaus plexippus 50(**), D. gilippus 2, Cercyonis sthenele 2, Coenonympha tullia 3, Adelpha bredowii 3(S), Limenitis lorquini 1(S), Precis coenia 20(S), Phyciodes mylitta 10, Nymphalis milberti 1, N. antiopa 2(S), Speyeria callippe macaria 5(S,N), S. hypaspe viridicornis 75(S,N), Habrodais grunus grunus 4, Satyrium saepium 5, S. sylvinus 2, S. californica 2, Callophrys nelsoni 1, Atlides halesus 6(S), Strymon melinus 6, Lycaena helloides 10 Brephidium exilis 2, Leptotes marina 2, Plebejus emigdionis 12(C,N), P. acmon 25(C,N), Colias eurytheme 5, Neophasia menapia 25, Pieris protodice 200(S,N), P. rapae 10(S,N), Papilio r. rutulus 5(S), P. eurymedon 10, Lerodea eufala 1, Ochlodes sylvanoides 2, Atalopedes campestris 4, Polites sabuleti 3, P. sonora 4, Hylephila phyleus 2, Pseudocopaeodes eunus 4, Erynnis propertius 1. Total 38 spp., about 450 individuals. (** All ID's from netted specimens unless otherwise noted - ed.)

Mt. Diablo, CA. 37°57'N, 121°52'W. See 1980 report for site localities. Elev: 4-1177 m. Habitat coverage: Juniper-Oak serpentine mtn top; Salix-Umbellularia-Quercus riparian; Adenostoma chaparral; riverine sand dune remnants with Salix-Quercus riparian margin; alkaline and brackish floodplain; urban. 3 July 1981; 0850-1650 hrs; 21-32°C; wind W, NW, variable. Six observers in three parties. Total party hours 20.75 (18.25 on foot, 2.5 by car); total party miles 79 (22 on foot, 57 by car, not observing). Observers: M.E. Buegler, J.A. DeBenedictis, R. Kelson, S. Meredith, D.J. Powell, J.A. Powell (201 Wellman Hall, Univ. of California, Berkeley, CA 94720). Conservation status; land uses: Antioch Dunes Nat'l Wildlife Refuge; Mt. Diablo State Park. Uniqueness: See 1980 report. Imminent threats: None. Changes since last year: None. Danaus plexippus 13(S), Cercyonis sthenele silvestris 124(S,C), Coenonympha california 53(S), Adelpha bredowi 20(S), Limenitis lorquini 9(S,N), Precis coenia 16(S), Phyciodes mylitta 14(S, N), Euphydryas chalcedona 1(N), Vanessa atalanta 1(S), Nymphalis antiopa 1(S), Speyeria callippe 23(S,C), Habrodais grunus 127(S,C), Satyrium saepium 91(S,C), S. tetra 28(C,N), Callophrys spinetorum 1(C), Strymon melinus 52(S,N), Lycaena arota 3(C,N), L. gorgon 5(C,N), L. xanthoides 7(S,N), Brephidium exilis 122(S), Celastrina argiolus echo 4(S), Plebejus acmon 50(S,N), Colias eurytheme 26(S,N), Pieris protodice 6 (S,N), P. rapae 121(S,N), Papilio zelicaon 16(S), P. rutulus 4(S), P. multicaudatus 12(S), P. eurymedon 13(S), Lerodea eufala 1(S), Ochlodes sylvanoides 2(S,N), O. agricola 13(S,N), O. yuma 1(C), Atalopedes campestris 1(C), Hesperia lindseyi 3(S,C), Polites sabuleti 9(S,N), Hylephila phyleus 23(S), Pyrgus communis 12(S), Erynnis tristis 26(S,C). Total 40 spp, about 1120 indiv. Larvae seen: D. plexippus 3(on Asclepias fascicularis); Euphydryas editha(?) 10 (on Penstemon heterophyllus); P. zelicaon 2 (on Foeniculum vulgare); Apodemia mormo langei 38 (on Eriogonum nudum). Eggs: L. gorgon ca 730 (on Eriogonum nudum). Field notes: There has been noticeable increase in stabilization of sand dune habitat due to weediness during the past two years at Antioch Nat'l Wildlife Refuge since aquisition by the Fish and Wildlife Service. Nonetheless, R.A. Arnold counted 38 larvae of A.m. langei in a 5 hr nocturnal search of Eriogonum in selected sites. A comparable search in 1980 showed 39 larvae. A dry winter (65% normal rainfall) and warm spring resulted in early drying of vegetation, with normal nectar sources mostly gone before July. Even so, butterflies/party hr increased from 50.4 in 1980 to 61.3 this year, in part because more emphasis was given to riverine and urban habitats. Early summer spp. (eg. gorgon, chalcedona, callippe, agricola) were in diminished numbers and ragged condition. Three parties averaged 36.5, 75.5 and 80.2 individuals/hr, while logging 25, 25 and 23 spp. respectively. Mt. Diablo, North Peak yielded 23 spp; Mt. Diablo Summit trail to upper Mitchell Cyn had 21; Antioch Wildlife Refuge and Mitchell Cyn, 17 each. Species observed during count week but not on count day: A.m. langei (larvae only), by R.A. Arnold on 6 July.

Palos Verdes Peninsula, CA. 33°44'N, 116°22'W, center 0.7 mi WSW intersection Palos Verdes Dr North and P.V. Dr East, includes Redondo Beach, Torrance, Wilmington, Carson, Lomita, Harbor City, San Pedro, Palos Verdes Peninsula. Elev: 0-450 m. Habitat coverage: Open ocean 46%; urban-industrial 31%; suburban residential and parks 12.5%; wooded areas 4.5%; open hillside and fields 4%; riparian 1%; fresh water marsh 1%; saltmarsh 1%. 4 July 1981; 0830-1630 hrs; clear all day; 22-27°C; wind E, 0-16 km/hr. Fifteen observers in one to three parties. Total party hours 12.5 (ten on foot, 2.5 by car); total party miles 37 (7 on foot). Observers: Douglas and Sally Buck, Betty Buzzini, Eric Hansen, Lois Ladenes, Tony Leigh, Jess Morton (787 W 4 St, San Pedro, CA 90731), Donna and Heather Morton, Bill Pearson, Hal Rupp, Betty Shaw, John Snider, Shirley Van Der Sluis, Walt Wright. Conservation status; land uses: Little open land left in this area and that is being swallowed for development. The only areas that will remain open will be those unstable for building. Last marshlands are also disappearing. Uniqueness: One small salt marsh is only known site for Panoquina sp. Palos Verdes blue very limited in distribution, but flies too early to be counted. Status of Philotes battoides unclear but it prefers the sloped in open area which are under pressure. Imminent threat: Development - especially to salt marsh area and to slopes used by Palos Verdes blue. Changes since last year: Continued development. Danaus plexippus 22(S), Precis coenia 2(S), Vanessa atalanta 1(S), V. carui 1(S), V. annabella 9(S), Nymphalis antiopa 11(S), Agraulis vanillae 49(S), Strymon melinus 29(S), Brephidium exilis 56(C), Leptotes marina 346 (N), Philotes battoides 11(C), Plebejus acmon 1(S), Phoebis sennae 6(C), Pieris rapae 172(N), Papilio zelicaon 3(S), P. rutulus 4(S), Panoquina panoquinoides 4(C), Lerodea eufala 6 (N), Atalopedes campestris 3(N), Polites sabuleti 5(N), Hylephila phyleus 57(N), Pyrgus communis albescens 10(N). Total 23 spp., about 833 indiv. Larae seen: Everes amyntula 3 (on Astragalus sp); A. vanillae 14 (on Passion flower); P. zelicaon 3 (on Fennel). Field notes: This is a new count with no one participant fully aquainted with the butterfly fauna of the area. Several species were missed that we now know were present. Next year we will have considerably better coverage with five to seven separate parties in the field at one time.

UCLA campus, CA. 34°04'N, 118°27'W, center SW of perimeter of campus. See 1980 report for area covered. 11 July 1981; 1500-1800 hrs; mostly clear to hazy; 22-26°C; wind WSW, 8-16 km/hr. One observer. Total party hours 3 (all on foot); total party miles 3. Observer: William C. Bakewell (10824 Lindbrook Dr, Apt 309, Los Angeles, CA 90024). Conservation status and land use: University campus. Uniqueness; Imminent threats; Changes since last year: None. Danaus plexippus 3(**), Nymphalis antiopa 1, Leptotes marina 6, Pieris rapae 2, Papilio rutulus 3, Hylephila phyleus 5. Total 6 spp., about 18 indiv. (** All butterflies identified by sight - ed.)

Willow Slough, Yolo County, CA. 38°34'N, 121°44'W, center 2.6 km N of Slide Hill Park, Davis. Habitat coverage: See earlier reports. 4 July 1981; 0800-1230 hrs; partly cloudy in AM to mostly cloudy in PM; 22-32°C; wind SSW, 0-6 km/hr. One observer. Total party hours 4.5 (all on foot); total party miles 8. Observer: Arthur M. Shapiro (Dept of Zoology, Univ of California, Davis, CA 95616). Conservation status; land uses; uniqueness; imminent threats: See previous reports. Changes since last year: Vegetation as rank as last year; still no fires since 1978; creek running despite only 77% normal rainfall. Melaneplus grasshoppers in 2nd year of outbreak, have completely defoliated white sweetclover in floodplain. June was hottest in over a century in Davis. Danaus plexippus 31 (**), Coenonympha t. california 1, Precis coenia 11, Phyciodes campestris 363(C), P. mylitta 1, Vanessa atalanta 1, V. cardui 10, V. virginiensis 1, V. annabella carye 7, Strymon melinus 25, Lycaena xanthoides 4, L. helloides 11, Brephidium exilis 1041, Plebejus acmon 38, Everes comyntas 18, Colias eurytheme 743(C), Pieris rapae 52, Papilio zelicaon 27(C), Lerodea eufala 21, Atalopedes campestris 18, Polites sabuleti 3, Hylephila phyleus 12, Pholisora catullus 19, Pyrgus scriptura 15, P. communis 11, Erynnis tristis 3. Total 26 spp., about 2488 indiv. Larvae seen: D. plexippus 20 (on Asclepias fascicularis); P. rapae 11 (on Lepidium latifolium); P. zelicaon 5 (on Foeniculum vulgar). Field notes: C. eurytheme count does not include adjacent alfalfa fields, where this species was in outbreak; tens of thousands flying, with windrows of dead ones by the roadsides. Biggest flight seen since

fall, 1973. All small, weedy butterflies and skippers are at very high levels, highest since 1978. P. rapae peaked earlier than in 1980, hence down; P. campestris apparently peaking, 2nd brood, right now. B. exilis arrived in area very early (17 May), ditto L. eufala (also 17 May), and both unusually fast in population buildup this year - exilis 2X previous high (1980). P. protodice still absent locally but numbers increasing in Rancho Cordova. V. cardui arrived very late this year but did breed locally. Noctuid moth Leucania unipuncta still in outbreak, even higher than in 1980. This count equals the previous high for species number (26 in 1977) and almost doubles the previous high for individuals (1439 in 1977) for this count. Both are in my estimation accurate reflections of this as a butterfly year. On 21 June, I counted 54 spp. at Donner Pass, a new 1 day record there and on 28 June, in 6 stops, a party of 3 observers saw 72 different species, between 4500' on the Sierran W slope and 4500' on the Sierran E side. This is a BIG butterfly year. (** All butterflies identified by light unless otherwise noted - ed.)

ZONE 2: NORTHWEST
(Oregon)

Portland, OR. 45°20'N, 122°45'W, center Insect Zoo, Washington Park (See 1978 report for description). Habitat coverage: Same as 1979. 11 July 1981; 1030-1430 hrs; partly cloudy in AM to mostly cloudy in PM; 13.3-22.2°C; wind WNW, 0-32.2 km/hr. Nine observers in one party. Total party hours 4 (2 on foot, 2 by car); total party miles 43 (3 on foot). Observers: John Hinchliff, Sue McMahon, Shane Newby, Josh Oken, Julie Oken, Nancy Pagaduan, Donna Primmer, Rick Westcott, Roger Yerke (Washington Park Zoo, 4001 SW Canyon Rd, Portland, OR 97221). Conservation status; land uses; uniqueness; imminent threats: See 1980 report. Changes since last year: None. Phyciodes mylitta 2(S), Vanessa atalanta 3(S), Pieris rapae 13(N), Papilio rutulus 35(S). Total 4 spp., about 53 indiv.

Utopia, OR. 44°30'N, 121°W, center T12S R14E Sec 8. See 1980 report for complete locality and habitat description. 12 July 1981; 1000-1400 hrs; mostly clear in AM to mostly cloudy with moderate rain in PM; 20-28°C. Twenty observers in five parties. Total party hours 14.25 (all on foot); total party miles 10.5. Observers: Jimbo Beckman, Dave Caraher, Linda Craig, Eric Eaton, Christie Galen (OMSI, 4015 SW Canyon Rd, Portland OR 97221), Marshall Gannett, Bruce Hansen, Mike Houck, Stan and Doris Jewett, Nathan Jones, Miranda Kahn, Durell Kapan, Leah Lukas, Kim McCarty, Kim Nelson, Mark Smith, Steve Shattuck, Greg Warden, Will Wright. Conservation status; land uses: Count area includes agricultural and range land. Mint, alfalfa and wheat are the main crops. Much of the range land is Artemesia tridentata and crested wheat. The springs are fenced for grazing protection as are many of the creek areas. Uniqueness; Imminent threats: See 1980 report. Changes since last year: None. Danaus plexippus 2(S), Cercyonis oetus 28(S) C. pegala 20(S), Coenonympha tullia 10(S), Limenitis lorquini 17(S), Phyciodes campestris 1(S), P. mylitta 9(S), Chlosyne palla 1(N), Euphydryas chalcedona 7(S,N), Vanessa atalanta 1 (S), V. cardui 4(S), V. annabella 1(S), Nymphalis milberti 6 (S), N. antiopa 1(S), Speyeria callippe 2(N), S. hydaspe 7(N) Satyrium fuliginosum 2(N), S. californica 26(S,N), Callophrys nelsoni 42(S), Lycaena rubidus 17(S), L. helloides 1(S), Philotes battoides 1(N), Phaedrotes piasus 1(N), Glaucopsyche lygdamus 1(N), Plebejus melissa 5(S), P. icarioides 39(S), Colias eurytheme 10(S,N), C. occidentalis 1(N), Pieris beckerii 6(N), P. occidentalis 34(S,N), P. rapae 71(S,N), Papilio rutulus 21(S,N), P. multicaudatus 13(S,N), P. eurymedon 12(S, N), Hesperia juba 3(S), H. comma harpalus 1(N). Total 36 spp, about 430 indivduals. Field notes: Sunny in the morning; cloudy with thunder and lightning and slight rain in the afternoon.

ZONE 3: ROCKY MOUNTAINS
(Colorado, Wyoming)

Cottonwood Pass, Gunnison-Chaffee Co., CO. 38°40'N, 106°45'W. See 1979 report for complete locality and habitat description. 20 July 1981; 1300-1700 hrs; clear to partly cloudy; 20-25°C; wind SE, 15-45 km/hr. Seven observers in five to seven parties. Total party hours 26 (all on foot); total party miles 25. Observers: Karolis Bagdonas (IBP Lab, 110 Biochemistry Bldg, University of Wyoming, Laramie, WY 82071), William Bagdonas, Chuck Farber, Mary Harter, Lorrie Lee, Claudia Tantillo, Becky Wills. Conservation status; Land uses; Uniqueness; Imminent threats: See 1979 and 1980 reports. Changes since last year: Even drier than in 1980, the tundra continues to take a beating, with additional loss of plant cover, especially near the Continental Divide parking lot and along the trails. More tourists, dust and trash than ever before. Oeneis chryxus 17(S,C**), O. uhleri 24, O. taygete 1(C), O. melissa 31, O. polixenes 5, Erebia magdalena 4(S), E. epipsodea 33, E. callias 3, Limenitis weidemeyerii 1(S), Phyciodes campestris 1(C), Chlosyne damoetus 9, Euphydryas anicia 23, Vanessa cardui 1(C), Nymphalis milberti 18, Speyeria mormonia 23, Boloria eunomia 5, B. titania 8, Lycaena dorcas 1(C), L. cupreus 34, Plebejus saepiolus 110+, P. shasta 68+, P. aquilo rustica 11, Colias philodice 5, C. eurytheme 1(C), C. alexandra 9, C. meadii 119+, C. scudderii 23, Pieris occidentalis 8, P. napi 29, P. rapae 1(C), Parnassius phoebus 120+, Polites draco 1(C), Pyrgus centaurae 1(S), Erynnis persius 2 (C). Total 34 spp., about 672 individuals. Field notes: A record 34 species were recorded this year compared to 26 in 1980 and 33 in 1979. However, populations for most species were down. Severe drought over the 1980-81 winter resulted in very dry conditions on the tundra and probable loss of many overwintering larvae and pupae. In the five years of this count, 1981 was the driest, and this followed a very dry summer of 1980. Only a third of the Parnassians seen in 1980 were on the wing in 1981 and this was a sixth of the number seen in 1978. In 1980, 160 E. callias were seen; only 2 in 1981. This may be related to a two year life cycle compounded by the drought. Our data tends to indicate the drought has had a drastic effect on this and other species' populations. (** All butterflies ID'd by sight/capture unless otherwise noted)

Gilpin Co., CO (Lower Circle). 39°50'N, 105°20'W, center Golden Gate Cyn Rd between Mt Tom and Douglas Mtn; new locality this year was circle center by JAS/GRS (1 mi SW Mt Tom). Elev: 1770-3200 m. Habitat coverage: As previously described. 12 July 1981; 0730-1600 hrs; mostly clear in AM to mostly cloudy with intermittent moderate rain in PM; 13.3-32.2°C; wind variable. Twelve observers in six to eight parties. Total party hours 35 (25 on foot, 10 by car); total party miles 85 (15 on foot). Observers: Dale Barlow, Peter Eades, David Ferguson, Mike Fisher, Don Philippson, Glenn R. Scott, James A. Scott, Charles Slater, Katharine Stanford, Linda Stanford, Ray E. Stanford (720 Fairfax St, Denver, CO 80220), Scott Stanford. Conservation status; Land uses; Uniqueness; Imminent threats: See 1980 report. Changes since last year: None. Danaus plexippus 7(C**), Neominois ridingsii 10, Erebia epipsodea 21, Cercyonis oetus 135, C. pegala 50, Coenonympha ochracea 24, Euptychia dorothea 7, Asterocampa celtis 42, Limenitis weidemeyeri 59, Phyciodes tharos 46, P. campestris 10, P. pallida 2, Chlosyne gorgone 24, C. nycteis drusius 60, C. palla calydon 32, Poladryas arachne 13, Euphydryas anicia 11, Polygonia satyrus 7, P. zephyrus 13, Vanessa atalanta 18, V. cardui 17, V. virginiensis 1, Nymphalis milberti 1(S by RES) N. californica 9, N. antiopa 29, Euptoieta claudia 62, Speyeria aphrodite ethne 60, S. edwardsii 3(N), S. atlantis hesperis 43, S. coronis halcyone 1(S by RES), S. callippe meadii 188, S. mormonia 5, Apodemia nais 21, Harkenclenus titus 30, Satyrium behrii 70, S. saepium 102, S. liparops aliparops 14, S. californica 14, S. acadica 1, Callophrys eryphon 2, C. siva 7, C. apama 11, Strymon melinus 20, Lycaena heteronea 359, L. xanthoides 3, L. rubidus 13, L. dorcas castro 11, Hemiargus isola 2, Philotes enoptes ancilla 5, Phaedrotes piasus 6, Glaucopsyche lygdamus oro 5, Celastrina argiolus 4, Plebejus melissa 2, P. saepiolus 26, P. icarioides 48, P. acmon 9, P. aquilo rustica 25, Everes comyntas 1, E. amyntula 16, Colias philodice eriphyle 3(S), C. eurytheme 18, C. alexandra 59, Eurema mexicana 1, Nathalis iole 1, Pieris protodice 130, P. occidentalis 4, P. napi 8, P. rapae 52, Euchloe ausonides 12, Papilio polyxenes 20, P. zelicaon 1, P. indra 3, P. rutulus 10, P. multicaudatus 17, P. eurymedon 2, Parnassius phoebus 110, Amblyscirtes aenus 3, A. oslari 1(S by RES), A. phylace 1, Euphyes vestris kiowah 45, Poanes t. taxiles 29, Atrytone delaware 5, A. arogos iowa 125, Ochlodes s. snowi 5, Hesperia u. uncas 3, H. p. pahaska 2, H. viridis 16, H. nevada 7, Oarisma g. garita 11, Polites mystic dacotah 1, Piruna pirus 12, Pyrgus c. communis 5, Erynnis icelus 2, E. p. pacuvius 1, E. persius fredericki 5, Thorybes mexicana nevada 1, Epargyreus c. clarus 5. Total 97 spp., about 2573 indiv. Field notes: Another new record this year! 97 species were

recorded in one day, despite it being an average year in many ways. Ten additional species were recorded by the team but they were outside the official circle (all 10 were in the uppper circle) for a total of 107 species, a new North Americain record. Had there been more spring species still out, or more exotic ones, we would have easily recorded over 100 for the lower circle. Perhaps another year. New in 1981 was E. comyntas, seldom found in the montane region of Colorado but common on the plains in some seasons. H. uncas and S. acadica were recorded for the second consecutive year. The Eades party recorded 72 species, the Stanford party 70 spp., the Scott party 68 species. L. heteronea was unusually common. 55 species were recorded in the Upper Circle but no formal report was filed this year. (** All specimens ID'd by capture unless otherwise noted - ed.)

Hall Valley, Park Co., CO. 39°28'N, 105°48'W. See 1979 report for complete locality and habitat description. 22 July 1981; 1100-1430 hrs; partly cloudy in AM to mostly cloudy in PM; 22-24°C; wind NW, 5-20 km/hr. Seven observers in five to seven parties. Total party hours 22 (all on foot); total party miles 17. Observers: Karolis Bagdonas (IBP Lab, 110 Biochemistry Bldg, University of Wyoming, Laramie, WY 82071), William Bagdonas, Chuck Farber, Mary Harter, Lorrie Lee, Claudia Tantillo, Becky Wills. Conservation status; Land uses; uniqueness: See 1980 report. Imminent threats: The road leading into Hall Valley has been significantly improved, opening the area to large recreational vehicles, dramatically increasing useage and potentials for damage. Changes since last year: Cattle have been removed, reducing the grazing impact. Several tee-pee rings, remnants of early indian use, were damaged by campers. Oeneis chryxus 5(S,C**), O. uhleri 8, Erebia epipsodea 5, Cercyonis oetus 2(C), Coenonympha tullia 26, Limenitis weidemeyerii 3, Phyciodes tharos 4, P. campestris 42, Polygonia satyrus 1(C), P. zephyrus 1(C), Vanessa cardui 1(C), Nymphalis milberti 1(C), N. antiopa 5, Speyeria aphrodite 3, S. atlantis 5, S. zerene 1(C), S. callippe 1(C), S. mormonia 25, Boloria titania 22, Lycaena heteronea 1(C), L. rubidus 66+, L. dorcas 12, Hemiargus isola 1(C), Plebejus melissa 1(C), P. saepiolus 63+, P. aquilo rustica 19, Colias philodice 4, C. eurytheme 1(C), C. alexandra 25, C. scudderii 1(C), Pieris protodice 1(C), P. occidentalis 3, P. napi 64+, P. rapae 1(C), Euchloe ausonides 1(C), Papilio rutulus 15, P. multicaudatus 1(C), P. eurymedon 4, Polites draco 3, P. themistocles 9, P. sonora 24, Pyrgus communis 1(C). Total 43 spp, about 372 individuals. Larvae seen: N. milberti 1016 (in two groups, 959 and 57, on Urtica dioica). Field notes: The 1981 count tied the 1980 record of 43 species. However, populations were down sharply from 1980 and previous years. Hall Valley was the driest we have seen it in the five year history of the count. Most flowers were badly stunted, wilted, and had few blooms or buds. Many did not bloom at all, although the season was advanced by over a week compared to 1980. (** All butterflies identified by sight/capture unless otherwise noted - ed.)

Highline Canal, CO. 39°45'N, 104°40'W, center The Hollow Tree, Del Mark Park, Aurora. See 1979 report for complete habitat description. 15 July 1981; 0930-1700 hrs; mostly clear in AM to partly cloudy with light rain in PM; 23-27°C; wind N, 0-10 km/hr. Nine observers in one to two parties. Total party hours 10 (8 on foot, 2 by car); total party miles 20 (9 on foot). Observers: Amy Chu, Janet Chu, Mary Margaret Golten, Lauren Golten, Ryan Golten, Carol Jones, Lynelle Jones, Pat McDermott, Robert M. Pyle (Swede Park, Loop Road, Box 123, Gray's River, WA 98621), Ronald Wahl, Jan White. Conservation status; land uses: See previous years' report. Now mostly residential and commercial with some open space, cemetery, park. Uniqueness: The Sand Creek area in particular remains a significant habitat enclave and open space in a continually expanding urban setting. Imminent threats: Annually, five per cent of the count circle is developed. This rate of development continues as Denver's suburbs expand. Very little habitat will remain soon except for gardens and parklands. Changes since last year: Additional development; greater amount of weediness due to disturbance of remaining open spaces. Danaus plexippus 21(**), Cercyonis pegala 89, Asterocampa celtis 17 (S), Limenitis archippus + hybrid 1 (see Field notes), L. weidemeyerii 3, Phyciodes picta 3, Chlosyne gorgone 97, Vanessa atalanta 4(S), V. cardui 35, Nymphalis antiopa 43(S), Euptoieta claudia 3(S), Speyeria aphrodite 3, Strymon melinus 8, Lycaena xanthoides 32, L. rubidus 32, L. dorcas 2(S), Hemiargus isola 4, Plebejus icarioides 1, P. acmon 1, Colias philodice 25, C. eurytheme 48, Nathalis iole 1(S), Pieris rapae 1663+, P. protodice 238, Papiolio polyxenes 6, P. rutulus 8, Poanes taxiles 4, Atrytone delaware 1(S), Pholisora catullus 13, Pyrgus communis 15, Erynnis funeralis 4, Epargyreus clarus 8. Total 32 spp., about 2434 indiv. Field notes: The great event was the finding of a wild hybrid L. archippus x L. weidemeyerii (L. "weidechippus"). A male in perfect condition, it was spotted by the compiler and later captured by Ron Wahl. This is only one of four or five specimens of this hybrid ever found in nature. An earlier example was taken a mile away (both locations are on Sand Creek in Aurora, CO) in 1964 by R.M. Pyle. The first specimen is in the Allyn Museum of Entomology, and this new specimen was donated to the Yale Peabody Museum of Natural History by R.M. Pyle and Ron Wahl. Most migrants were in good numbers in Colorado, esp. E. claudia; H. isola low however. P. icarioides turned up in a lupine patch at Fairmount Cemetery for the first time in several years of checking. Generalists such as C. gorgone continue to thrive in this urbanizing circle, specialists such as S. aphrodite diminish. Most of the current fauna is composed of weedy species. All three species of coppers recorded were nectaring together on flowers of watercress spp. emergent in Sand Creek, with L. rubidus most numerous. (** denotes specimens identified in the net, all others as indicated - ed.)

Maroon Lake, Pitkin Co., CO. 39°06'N, 107°56'W. See 1979 report for complete locality and habitat description. 18 July 1981; 1100-1600 hrs; mostly cloudy in AM to partly cloudy in PM; 19-24°C; wind NW, 5-17 km/hr. Seven observers in one to seven parties. Total party hours 29 (all on foot); total party miles 21. Observers: Karolis Bagdonas (IBP Lab, 110 Biochemistry Bldg, University of Wyoming, Laramie, WY 82071), William Bagdonas, Chick Farber, Mary Harter, Lorrie Lee, Claudia Tantillo, Becky Wills. Conservation status; Land uses; Uniqueness; Imminent threats: See earlier reports. Changes since last year: Despite heavy use by tourists, Hikers and campers that continues to rise, restricted road traffic, tougher camping regulations and fence barriers along heavily impacted trails have resulted in marked improvements of the environmental quality of the area. Plant recovery over the last several years has been remarkable. It's most improved in 1981. Oeneis chryxus 5(S,C**), Erebia epipsodea 9, Cercyonis oetus 13, Coenonympha tullia 11, Limenitis weidemeyerii 5 Phyciodes tharos 3, P. campestris 11, Poladryas arachne 26, Euphydryas anicia 25,,Polygonia zephyrus 1(C), Vanessa atalanta 2(S), V. cardui 3, Nymphalis milberti 18, N. antiopa 2(S), Speyeria aphrodite 1(C), S. cybele 11, S. atlantis 9, S. coronis 1(C), S. zerene 6, S. callippe 5, S. mormonia 20, Boloria titania 9, Lycaena heteronea 8, L. rubidus 107+, L. nivalis 1(C), L. dorcas 38, Hemiargus isola 1(C), Glaucopsyche lygdamus 1(C), Plebejus melissa 2(C), P. saepiolus 14, P. icarioides 1(C), P. shasta 9, P. aquilo rustica 71+, Everes amyntula 3(C), Colias philodice 3, C. alexandra 13, Phoebis sennae 1(S), Pieris occidentalis 16, P. napi 57+, P. rapae 4, Euchloe ausonides 2(C), Papilio rutulus 5, P. multicaudatus 1(C), Polites draco 5, Erynnis persius 1(C), Thorybes mexicana 1(C). Total 46 spp., about 483 individuals. Larvae seen: N. milberti 42 (on Urtica dioica). Field notes: In 1981, a new record of 46 species was set over the previous record of 40 in 1980. However, continued dry conditions from 1980 resulted in fewer specimens being logged. A week of heavy rains prior to the count did help freshen previously wilted vegetation. We had camped for three days along Lincoln Cr outside of Aspen while we waited for the weather to break. In that time, vegetation which had been badly damaged by the long draught was able to partially recover. On the count day, most vegetation appeared quite green and fresh although shorter than in previous years. (** All butterflies identified by sight and capture unless otherwise noted - ed.)

Paonia Reservoir, Gunnison Co., CO. 39°57'N, 107°21'W. See 1979 report for complete locality and habitat description. 19 July 1981; 0930-1630 hrs; clear in AM to partly cloudy in PM; 27-37°C; wind NW, 0-20 km/hr. Seven observers in five to seven parties. Total party hours 41 (40 on foot); 1 by car); total party miles 38 (33 on foot). Observers: Karolis Bagdonas (IBP Lab, 110 Biochemistry Bldg, University of Wyoming, Laramie, WY 82071), William Bagdonas, Chuck Farber, Mary Harter, Lorrie Lee, Claudia Tantillo, Becky Wills. Conservation status; Land uses; Uniqueness; Imminent threats: See 1979 report. Changes since last year: Road construction has dropped over the past year yet more dust covered the vegetation, reflecting the continued drought of 1980-81. Danaus plexippus

38(S,C**), Oeneis uhleri 1(C), Cercyonis oetus 139+, C. pegala 68, Coenonympha tullia 2(C), Limenitis weidemeyerii 9, Phyciodes campestris 15, Polygonia faunus 1(C), P. zephyrus 3(C), Vanessa atalanta 1(S), V. cardui 8, Nymphalis milberti 3(S), N. antiopa 1(S), Euptioeta claudia 1(C), Speyeria cybele 54, S. aphrodite 10, S. atlantis 65+, S. coronis 14, S. zerene 18, S. callippe 17, Hypaurotis crysalus 117+, Satyrium behrii 1(C), S. liparops 12, S. calanus 6, S. sylvinus 31, S. californica 6, Lycaena heteronea 3, L. arota 12, L. rubidus 12, L. dorcas 4(C), Glaucopsyche lygdamus 1(C), Plebejus melissa 5, P. saepiolus 1(C), Colias philodice 16, C. eurytheme 3, C. alexandra 1(C), Pieris protodice 1(C), P. occidentalis 4(C), P. napi 3, P. rapae 11, Papilio zelicaon 1(S), P. rutulus 8, P. multicaudatus 3, Euphyes vestris 1(C), Ochlodes sylvanoides 32, O. snowi 1(C), Hesperia pahaska 16, Polites themistocles 2(C), Piruna pirus 3(C), Pyrgus communis 6. Total 50 spp., about 654 individuals. Larvae seen: N. milberti 2 (on Urtica dioica); V. cardui 1 (on Cirsium sp.). Field notes: A record year with 50 species recorded compared to 35 in 1980. The weather on the count day was scorching but the butterfly diversity and numbers were both impressive. The continued 1980-81 drought affected most vegetation in the area quite severely. Many flowers didn't bloom this year and others were stunted or killed by the dry heat. Construction pressures have abated somewhat, so environmental damage could be improved in the next few years - if the drought breaks. (** All butterflies identified by sight/capture unless otherwise noted - ed.)

Rattlesnake Jack's, Skin Gulch, Larimer Co., CO. 40°40'N, 105°23'W. See 1980 report for complete locality and habitat description. 14 July 1981' 1100-1445 hrs; partly cloudy in AM to clear in PM; 28-31°C; wind NW, 10-25 km/hr. Six observers in three to five parties. Total party hours 21.5 (all on foot); total party miles 24. Observers: Karolis Bagdonas (IBP Lab, 110 Biochemistry Bldg, University of Wyoming, Laramie, WY 82071), Chuck Farber, Mary Harter, Lorrie Lee, Claudia Tantillo, Becky Wills. Conservation status; Land uses; Uniqueness; Imminent threats: See 1980 report. Changes since last year: The U.S. Forest Service has removed the old cabins belonging to Rattlesnake Jack's children and have tried to impose regulations on the many hikers, picnickers and campers who commonly use the area, but to no avail. Habitat destruction continues. Danaus plexippus 3(S,C**), Cercyonis oetus 71+, Coenonympha tullia 4(C), Limenitis weidemeyerii 2(S), Phyciodes tharos 10, P. campestris 3(C), Chlosyne gorgone 3 (C), Euphydryas anicia 1(C), Polygonia zephyrus 14, Vanessa atalanta 23, V. cardui 13, Nymphalis milberti 1(S), N. antiopa 20, Euptoieta claudia 14, Speyeria aphrodite 2(C), S. zerene 3 (C), S. edwardsii 3, S. atlantis 1(C), S. coronis 2(C), S. callippe 2(C), Satyrium behrii 10, S. liparops 1(C), S. californica 3, Collophrys siva 6, Lycaena heteronea 66+, Hemiargus isola 1(C), Philotes enoptes 1(C), Plebejus saepiolus 1 (C), P. acmon 4(C), P. aquilo rustica 1(C), Everes amyntula 1 (C), Colias philodice 20, C. eurytheme 23, C. alexandra 27, Pieris occidentalis 35+, P. protodice 28, Papilio polyxenes 6 P. rutulus 11, P. multicaudatus 8, P. eurymedon 6, Parnassius phoebus 78, Euphyes vestris 25, Poanes taxiles 1(C), Hesperia pahaska 1(C), H. viridis 1(C), Piruna pirus 15, Epargyreus clarus 1(C). Total 47 spp., about 475 individuals. Field notes: In 1981, we recorded 10 fewer species than in 1980. The number of specimens recorded was about half of 1980 too. The continued drought has severely affected most butterfly populations as well as vegetation. Many summer flowers didn't bloom or had few buds or blossoms. All were stunted. The Ponderosa Pine beetle and man are also severely damaging or destroying trees. Many living trees were cut by campers over the last year. Combined, these detrimental factors have continued to destroy a once pristine valley. Efforts to save the area, made over the last few years by the U.S. Forest Service, have been, for the most part, ineffective. Butterfly diversity and floral diversity remain high in Skin Gulch despite the 1980-81 drought, man and insect pests.

Rocky Mountain Nat'l Park, CO. 40°20'N, 105°40'W, center at Bear Lake, RMNP. See 1978 report for count sites. Habitat coverage: Willow-sedge meadow, sage flat, ponderosa pine-Douglas fir forest, subalpine fir forest, subalpine meadow, arctic-alpine tundra and rockslide, roadsides through above. 11 July 1981; 0930-1630 hrs; mostly clear in AM to mostly cloudy with intermittent rain in PM; 19-24°C; wind W, 0-15 km/hr. Six observers in one to two parties. Total party hours 7 (6 on foot, 1 by car); total party miles 30+ (4 on foot). Observers: Amy Chu, Janet Chu, Kathy Glassner, Carol Jones, Steve Pattee, Robert M. Pyle (Swede Park, Loop Rd, Box 123, Gray's River, WA 98621). Conservation status; land uses: YMCA camp, national park. Uniqueness: See 1978 report. Imminent threats: None noticed. Changes since last year: Human impact of tundra is worse in places, but efforts are being made by the Nat'l Park Service to mitigate this. Mortality or severe effects of mountain pine beetle upon forest conifers (as well as that of spruce budworm) noticeably worse, which should not effect butterflies unless control measures are carried out (with possible exception of Neophasia menapia). Oeneis melissa 6(S-RMP), Erebia magdalena 12(S-RMP), E. epipsodea 1(S-RMP), Cercyonis oetus 1(N), Coenonympha tullia (ochracea) 21(S), Phyciodes tharos 12(N), P. campestris 1(N), Polygonia satyrus 1(N), P. hylas 1(S-RMP), Vanessa atalanta 3(N), V. cardui 9(N), Nymphalis californica 1(S-RMP), N. antiopa 3(S), Euptoieta claudia 1(S-RMP), Speyeria callippe 1(S-RMP), S. mormonia 1(N), Boloria titania 10(S), Lycaena rubidus 15(N), L. cupreus 2(S), Plebejus saepiolus 1 (N), P. acmon 2(N), Colias eurytheme 3(S), C. alexandra 20 (S), C. meadi 1(S), C. scudderii 10(N), Pieris occidentalis 2(S), P. rapae 5(N), P. napi 22(N), Papilio polyxenes 1(S), P. rutulus 7(S), P. multicaudatus 1(S), Parnassius phoebus 12(S), Oarisma garita 26(N), Pyrgus centaureae 2(S,N). Total 34 spp., about 217 indiv. Field notes: Due to inclement weather in the afternoon, the period designated this year to count the lowland part of the circle, a number of low altitude species were missed altogether, notable blues. The spp. total is therefore artificially low. Emergence in the low to mid elevation sector (7-8000 feet) was early this year, but tundra species normal; this is the first year that Cercyonis oetus has been recorded this early in five years. Chlosyne nycteis was apparently absent from the Fall River aspen meadows where it has been found in previous counts, but this may have been due to showers which kept most butterflies down amongst the sedges.

Weston Pass, Lake-Park Co., CO. 39°08'N, 106°11'W. See 1979 report for complete locality and habitat description. 21 July 1981; 1100-1630 hrs; clear all day; 19-23°C; wind NW, 10-40 km/hr. Six observers in four to six parties. Total party hours 31 (all on foot); total party miles 39. Observers: Karolis Bagdonas (IBP Lab, 110 Biochemistry Bldg, University of Wyoming, Laramie, WY 82071), William Bagdonas, Mary Harter, Lorrie Lee, Claudia Tantillo, Becky Wills. Conservation status; Land uses; Uniqueness; Imminent threats: See 1980 report. Changes since last year: More people are using the improved dirt road as a short cut over the Continental Divide. Oeneis chryxus 18(S,C**), O. uhleri 23, O. melissa 9, O. polixenes 4, Erebia magdalena 7, E. epipsodea 187+, E. callias 48, Cercyonis oetus 2(C), Coenonympha tullia 1(C), Limenitis weidemeyerii 1(S), Phyciodes campestris 14, Chlosyne damoetus 54, Euphydryas anicia 56, Polygonia zephyrus 1(C), Vanessa cardui 1(C), Nymphalis milberti 21, Euptoieta claudia 1(C), Speyeria atlantis 3, S. mormonia 23, Boloria titania 109+, Lycaena rubidus 1(C), L. cupreus 18, Hemiargus isola 1(C), Plebejus melissa 3, P. saepiolus 267+, P. shasta 15, P. aquilo rustica 44, Colias philodice 7, C. eurytheme 1(C), C. alexandra 19, C. scudderii 13, Phoebis sennae 1(C), Pieris occidentalis 9, P. napi 40, Anthocaris sara 1(C), Euchloe ausonides 1(C), Papilio zelicaon 1(C), P. rutulus 3, P. multicaudatus 1(C), P. eurymedon 4, Parnassius phoebus 145+, Polites draco 187+, Pyrgus centaurae 3, Erynnis persius 2(C). Total 46 spp., about 1578 individuals. Field notes: In 1981, we recorded an impressive record 46 species compared to 32 species in 1980 and 35 in 1979. However, the number of individuals seen was greatly reduced from 1980. The tundra was extremely dry and specimens were already worn even though the count was conducted a week earlier than in 1980. Weston Pass, like most of Colorado, suffered a severe drought in 1980-81. Most bogs were dry or nearly so; most flowers were stunted and wilted. The reduction in butterflies was best exemplified by a small bog which had water both this year and last. However, in 1980, over 500 butterflies were seen nectaring on Senecio in the 3 m diameter area. This year, less than 40 were seen, even though the Senecio was again in bloom. (** All butterflies identified by sight/capture unless otherwise noted - ed.)

Colter Canyon, Grand Teton Nat'l Park, WY. 43°56'N, 110°44'W. See 1979 report for complete locality and habitat description. 11 July 1981; 0800-1700 hrs; mostly clear in AM to mostly cloudy with intermittent light rain in PM; 10-26°C; wind SE, 11-46 km/hr. Three observers in one to three part-

ies. Total party hours 27 (all on foot); total party miles 17.3. Observers: Barbara Bracewell, John Carlisle (c/o Karolis Bagdonas, IBP Lab, 110 Biochemistry Bldg, Univ of Wyoming Laramie, WY 82071), Robert Davis. Conservation status; Land uses; Uniqueness; Imminent threats: See 1980 report. Changes since last year: None. Danaus plexippus 12(S,C**), Oeneis chryxus 37, O. melissa 8, Erebia magdalena 41, Cercyonis oetus 36, Coenonympha haydenii 29, Limenitis weidemeyerii 24, Phyciodes tharos 16, Chlosyne palla 17, Euphydryas anicia 4, E. editha 53, Polygonia zephyrus 2(S), Nymphalis milberti 28, Lycaena dorcas 7, Philotes enoptes 10, Glaucopsyche lygdamus 32, Plebejus saepiolus 1(C), P. icarioides 33, P. acmon 1(C), Colias philodice 3, Pieris sisymbrii 8, P. napi 9, Anthocaris sara 9, Euchloe ausonides 2(S), Papilio zelicaon 28, P. rutulus 36, P. multicaudatus 9, P. eurymedon 11, Parnassius clodius 12, P. phoebus 25, Carterocephalus palaemon 7, Pholisora catullus 3, Pyrgus centaureae 1(C), P. ruralis 9, Erynnis persius 8. Total 35 spp., about 443 indiv. Field notes: Colter Cyn is an exceptionally beautiful area within Grand Teton Nat'l Park. The variable habitats from a burned coniferous forest on Jackson Lk to the talus slopes of jagged peaks above 10,000 ft made a very interesting variety in our count, from lower bog and wetland species to alpine tundra and talus spp. The 1981 count set a new record of 35 spp. over the previous record of 27 spp. set in 1980. This 3rd year count is part of a larger study of the Lepidoptera fauna of Grand Teton Nat'l Park and is supported by grants from the University of Wyoming and the Nat'l Park Svc.

Lost Creek, Grand Teton Nat'l Park, WY. 43°45'N, 110°36'W. See 1979 report for complete locality and habitat description. 9 July 1981; 0950-1400 hrs; mostly clear all day; 20-27°C; wind NE, 16-40 km/hr. Three observers in one to three parties. Total party hours 12 (all on foot); total party miles 12. Observers: Barbara Bracewell, John Carlisle (c/o Karolis Bagdonas, IBP Lab, 110 Biochemistry Bldg, Univ of Wyoming, Laramie, WY 82071), Robert Davis. Conservation status; Land uses; Uniqueness; Imminent threats: See 1980 report. Changes since last year: None. Oeneis jutta 1(C), Erebia epipsodea 1(C), Cercyonis oetus 114(S,C**), Coenonympha tullia 198, C. haydenii 46, Limenitis weidemeyerii 11, Euphydryas editha 17, Nymphalis milberti 2(S), Speyeria zerene 2(C), S. callippe 16, S. mormonia 23, Lycaena editha 32, L. cupreus 1(C), Philotes enoptes 50, Phaedrotes piasus 26, Glaucopsyche lygdamus 50, Plebejus saepiolus 1(C), P. icarioides 64, P. acmon 35, P. aquilo rustica 16, Colias alexandra 1(C), Pieris sisymbrii 11, P. napi 3(S), Papilio zelicaon 18, P. rutulus 15, P. eurymedon 8, Parnassius clodius 6, P. phoebus 35, Oarisma garita 80, Polites draco 5, Erynnis persius 10. Total 31 species, about 660 indiv. Field notes: The exceptionally beautiful day of the count over the cloudy weather in 1980 undoubtedly helped in setting a new record of 32 spp compared to last year's 26. This 3rd year count at Lost Creek is part of a larger study of the Lepidoptera fauna of Grand Teton Nat'l Park and is supported by grants from the University of Wyoming and the National Park Service. (** All butterflies identified by sight and capture unless otherwise noted - ed.)

Signal Mtn, Grand Teton Nat'l Park, WY. 43°51'N, 110°34'W. See 1979 report for complete locality and habitat description. 8 July 1981; clear all day; 9-26°C; wind NE, 3-16 km/hr. Three observers in one to three parties. Total party hours 18 (all on foot); total party miles 9.5. Observers: Barbara Bracewell, John Carlisle (c/o Karolis Bagdonas, IBP Lab, 110 Biochemistry Bldg, Univ of Wyoming, Laramie, WY 82071) Robert Davis. Conservation status; Land uses; Uniqueness; Imminent threats: See 1980 report. Changes since last year: None. Danaus plexippus 1(S), Oeneis jutta 1(C), Erebia epipsodea 16(S,C), Coenonympha haydenii 44(S,C), Phyciodes tharos 15(S,C), Euphydryas editha 88(S,C), Polygonia zephyrus 2(S), Nymphalis milberti 3(S), N. antiopa 3(S), Speyeria atlantis 1(C), S. zerene 78(S,C), S. callippe 26(S,C), S. egleis 1(C), S. mormonia 10(S,C), Boloria kriemhild 2(C), Callophrys affinis 10(S,C), C. sheridanii 2(C), Philotes enoptes 90(S,C), Phaedrotes piasus 11(S,C), Glaucopsyche lygdamas 50(S,C), Plebejus icarioides 114(S,C), Everes amyntula 8(S,C), Colias philodice 2(C), Pieris sisymbrii 15(S,C), P. napi 17(S,C), Euchloe ausonides 15(S,C), Papilio rutulus 20 (S,C), P. multicaudatus 1(S), P. eurymedon 11(S,C), Parnassius phoebus 13(S,C), Hesperia comma 1(C), Pholisora catullus 10(S,C), Erynnis icelus 7(S,C), E. persius 28(S,C). Total 34 spp., about 525 individuals. Field notes: In 1981, a new record of 34 species was set over 1980's record of 26. This 3rd year count is part of a continuing larger study of the Lepidoptera fauna of Grand Teton Nat'l Park, supported by grants from the University of Wyoming and the National Park Service Research Center. Most specimens were released if not needed for the continuing studies.

Snowy Range, Albany County, WY, 45°22'N, 106°15'W. See 1980 report for complete locality and habitat description. 24 July 1981; 1045-1400 hrs; partly cloudy in AM to mostly cloudy in PM; 18-21°C; wind NW, 7-22 km/hr. Seven observers in six to seven parties. Total party hours 22 (20 on foot, 2 by car); total party miles 17 (15 on foot). Observers: Karolis Bagdonas (IBP Lab, 110 Biochemistry Bldg, University of Wyoming, Laramie, WY 82071), William Bagdonas, Cliff Ferris, Mary Har-Ter, Lorrie Lee, Claudia Tantillo, Becky Wills. Conservation status; Land uses; Uniqueness: See 1980 report. Imminent threats: Proposed widening of the Snowy Range Road. The proposal is being fought in the courts by the Save the Snowies environmental group (unfortunately, developers appear to be winning). Changes since last year: The area was much drier than in 1980 due to the continued drought. Limenitis weidemeyerii 2(S), Phyciodes campestris 13(**), Euphydryas anicia 3, E. editha 3, Nymphalis milberti 43+, Speyeria edwardsii 3, S. atlantis 9, S. zerene 3, S. mormonia 45+, Boloria eunomia 48, B. titania 19, Lycaena dorcas 43, Plebejus saepiolus 338+ P. icarioides 13, P. aquilo rustica 226+, Colias philodice 3, C. alexandra 30, C. meadii 364+, C. scudderii 73, Pieris occidentalis 5, P. napi 24, Papilio rutulus 1(S), Parnassius phoebus 644+, Oarisma garita 3, Polites draco 3, P. sonora 1, Pyrgus centaureae 3. Total 27 spp., about 1721 indiv. Field notes: The weather on this second year count was more typical of the cool, cloudy conditions normally seen in the Snowy Range. The beautiful clear day of the 1980 count was exceptional. Normally, the mornings in July are clear to partly cloudy with cloudy conditions prevailing in the afternoon. Such was the case this year. As a result, less than half the species seen last year were recorded this year. Drier conditions as a consequence of the continuing 1980-81 drought were evident. Bogs which were knee deep in water last year were ankle deep or dry in 1981. Ridges and other high areas were more severely affected. Plants were smaller with fewer blooms and some butterflies, common in 1980, were absent or nearly so this year. This was especially true for many nymphalids and satyrids. (** All butterflies identified by capture and sight unless otherwise noted - ed.)

ZONE 4: GREAT PLAINS
(Nebraska)

Rowe Sanctuary, NE. 40°37'30"N, 98°52'30"W. Includes SE ¼ of R14W T8N, Sec 11. Elev: 634 m. Habitat coverage: 40% alfalfa; 30% wet meadow; 30% riparian forest. 4 July 1981; 0800-1100 hrs; mostly cloudy; 20-22°C; wind N, 0-5 km/hr. Two observers in one party. Total party hours 3 (all on foot); total party miles 2. Observers: Harold G. Nagel (Rt 3, Kearney, NE 68847) Lyle White. Conservation status; Land uses: Audubon bird sanctuary. Uniqueness; Imminent threats: See 1980 report. Changes since last year: None. Cercyonis pegala 21(**), Euptychia cymele 13, Vanessa atalanta 1, Speyeria idalia 2, Lycaena hyllus 1, Everes comyntas 2, Colias eurytheme 5, Nathalis iole 5, Pieris protodice 3, Pholisora catullus 1, Pyrgus communis 2. Total 11 spp., about 56 indiv. Field notes: Alfalfa had been mowed. S. idalia was abundant on the wet meadow site one week previous.

ZONE 5: EASTERN-MIDWEST
(Illinois, Ohio)

McGraw Wildlife Foundation, IL. 42°04'N, 88°08'W, center SW corner Sec 36, Barrington Twp. See 1980 report for complete locality and habitat cescription. 3 July 1981; 0900-1710 hrs; mostly clear all day; 24-32.2°C; wind S, 5-10 km/hr. Four observers in two parties. Total party hours 12 (9 on foot, 3 by car); total party miles 28.5 (9.5 on foot). Observers: George V. Burger (1766 Country Knolls Ln, Elgin, IL 60120), Jeannine W. Burger, Robert A. Montgomery, Wayne E. Schenam. Conservation status; land uses; uniqueness: See 1980 report. Imminent threats: Reduced, Bluff City Blvd Fen now seems safe due to

actions of local "Save the Fen" citizens' group, spearheaded by McGraw Wildlife Foundation personnel. Changes since last year: None. Danaus plexippus 5(S), Cercyonis pegala 4(S), Euptychia cymele 45(N), Lethe portlandial9(N), L. eurydice 20 (N), Asterocampa celtis 1(S), A. clyton 5(N), Limenitis archippus 4(S), L. astyanax 8(S), Precis coenia 1(S), Phyciodes tharos 10(S), Chlosyne nycteis 32(S), Euphydryas phaeton 29 (S), Polygonia interrogationis 8(S), P. comma 5(S), Vanessa atalanta 33(N), V. cardui 3(S), V. virginiensis 6(N), Nymphalis antiopa 3(S), Speyeria cybele 12(S), Feniseca tarquinus 1 (N), Harkenclenus titus 10(C), Satyrium liparops strigosa 1 (C), S. calanus 4(C), S. edwardsii 11(C), S. acadica 19(C), Lycaena hyllus 5(C), Celastrina argiolus 4(N), Everes comyntas 9(S), Colias philodice 103(S), C. eurytheme 41(S), Eurema lisa 1(S), Pieris rapae 68(S), Papilio polyxenes 5(S), Poanes massasoit 10(C), Atrytone delaware 4(C), Pompeius verna 1(C), Thymelicus lineola 300+(C), Thorybes pylades 5(N), Epargyreus clarus 2(S). Total 40 spp., about 860+ indiv. Larvae seen: N. antiopa 18 (on Ulmus sp.). Field notes: "Fen" area accounted for all E. phaeton, C. nycteis, L. eurydice and several of the Hesperiids encountered. Increased numbers of species and individuals noted compared to 1980. Most likely due to one additional trained observer enabling better coverage (of same areas within count area) by two parties, and a phenologically early spring (the first such significantly early in the past 14 years) contributed to some overlap of species missed in 1980 because they were earlier or later. The unusual (for us) abundance of V. atalanta possibly due to over wintering adults in a very mild winter. Many worn adults seen as early as April. S. cybele remains more common than in years. P. glaucus remains rare.

Adams County Preserves, OH. 42°09'N, 86°W, center 1 km E of Cave Hollow, includes Buzzards Roost, Red Rock, Abner Hollow, The Wilderness, Lynx Prairie, Preserves of the Cincinnatie Museum of Natural History. Elev: 9.99-27.45 m. Habitat coverage: Mixed hardwoods 35%, upland hardwoods 30%, eroded field/red cedar 15%, bottomland hardwoods 10%, dry meadows 5%, prairie remnants 5%. 12-13 July 1981; 1300-1500 and 0900-1200 hrs; clear all days; 31-34°C; wind SW, 24-32 km/hr. Thirty-four observers in one to four parties. Total party hours 19 (16 on foot, 3 by car); total party miles 92 (24 on foot). Observers: Susan Kains Ahearn (1003 Oak St, Columbus, OH 43205), Paul Andrendis, Helen Black, Robert Booker, Tom Breckel, Krishna Brutoro, Jean Firaci, Jeremy Folger, Gardiner Goodrich, David Imbrogno, Norma Lewis, Vince Lucas, John Neupauer, Ruth Neupauer, Nancy Ottman, Beth Riestenberg, Meg Riestenberg, Joan Rieusche, Louise Rowe, Andrew Vitz, Robert Vitz, Kevina Vulinec, Reed Watkins, Sally Woliveri, Don Wright Robby Wright + 8 folks whose names we missed. Conservation status; land uses: Nature preserves belonging to the Cincinnatie Museum of Natural History. Uniqueness: Relic prairies. Imminent threats: Encroachment of forest into the prairie remnants; off-road vehicles; garbage dumps by local residents; buffer lands disappearing to development of trailer parks. Changes since last year: First year count. Cercyonis pegala 13(S,C,N), Euptychia cymela 28(S,N), Lethe portlandia 1(C), Asterocampa clyton 1(C), Limenitis astyanax 2(N), Phyciodes tharos 35(S,C,N), Polygonia interrogationis 7(S), P. comma 2 (S), Vanessa atalanta 5(S,N), V. virginiensis 1(S), Speyeria cybele 86(S,C,N), S. aphrodite 3(C,N), Boloria bellona 19(S, C,N), Libytheana bachmanii 2(S,C), Calephelis borealis 11(S, C), Feniseca tarquinius 1(C), Satyrium calanus 3(C,N), Callophrys gryneus 6(S,C,N), Strymon melinus 2(C,N), Celastrina argiolus 4(S,CN), Everes comyntas 13S,C,N), Colias philodice 2(S,N), C. eurytheme 12(S,N), Eurema lisa 27(S,C,N), E. nicippe 2(C), Pieris rapae 2(S), Battus philenor 19(S,C,N), Papilio glaucus 17(S,N), P. polyxenes 1(S), P. troilus 12(S, N), Amblyscirtes vialis 1(C), Atrytone delaware 4(S,N), Pompeius verna 4(S,C,N), Polites origenes 2(C), Ancyloxypha numitor 2(S), Thorybes pylades 4(S,C), Epargyreus clarus 85(S, C,N). Total 37 spp., about 541 individuals. Field notes: P. glaucus - brown form of female seen often. C. gryneus - 2 males and a female involved in a spiral flight above a red cedar tree for 5 minutes, a male flew off and the remaining pair alit on top of the cedar. One each D. plexippus and A. celtis seen but not during count period.

Cleveland Heights-Holden Arboretum, OH. 41°30'N, ca. 81°W. See 1980 report for full locality and habitat description. 11 July 1981; 1100-1300 and 1430-1600 hrs; clear all day; 27-31°C; wind slight. One observer. Total party hours 3.5 (all on foot); total party miles 5. Observer: Julie Clemens (2258 Lamberton Rd, Cleveland Hgts, OH 44118). Conservation status; land uses; uniqueness; imminent threats: See 1980 report. Changes since last year: None. Danaus plexippus 1(S) Cercyonis pegala 121(N), Euptychia cymela 1(N), Phyciodes tharos 9(N), Vanessa atalanta 10(N), V. virginiensis 2(N), Nymphalis antiopa 1(S), Strymon melinus 2(N), Lycaena phlaeas 20(N), Colias philodice 8(N), C. eurytheme 1(N), C. interior 1(N), Pieris rapae 8(N), Papilio glaucus 1(S), P. polyxenes 2(N), Amblyscirtes vialis 3(N), Epargyreus clarus 9(N). Total 19 spp., about 255 individuals. Field notes: Numbers of C. philodice and P. rapae down from last year (compare 94 & 85 from 1980 with 8 & 8 this year). Additional butterflies seen during count week but not on count day: Limenitis archippus, Boloria toddi, Satyrium acadica, Celastrina argiolus.

ZONE 6: SOUTHEAST
(Florida, Louisiana, Mississippi, Virginia)

W.J. Janes Memorial Drive, Copeland, FL. 26°03'N, 81°23'W. See 1980 report for complete locality and habitat description. 8 July 1981; 0900-1600 hrs; clear all day; 27.7-34.4°C; wind nil. Two observers in one party. Total party hours 7 (1 on foot, 6 by car); total party miles 13 (1 on foot). Observers: James C. Begg (Apt 1102, 710 N Ocean Blvd, Pompano Beach, FL 33062), Ada Ginsburg. Conservation status; Land uses; Uniqueness; Imminent threats: See 1980 report. Changes since last year: None. Danaus gilippus 100+(S), Euptychia hermes sosybia 1(N), E. areolata 1(N), Marpesia petreus 33 (S), Limenitis archippus 52(S), Precis evarte 22(S), Anartia jatrophae 45(S), Phyciodes phaon 30(S), P. tharos 80(S), Heliconius charitonius 14(S), Agraulis vanillae 8(S), Calephelis virginiensis 1(N), Strymon cecrops 1(N), S. melinus 1(N), Colias cesonia 1(N), Phoebis sennae 4(S), Eurema nicippe 2(S), Nathalis iole 12(S), Pieris protodice 1(N), Ascia monuste 4(N) Papilio polyxenes 3(N), P. cresphontes 2(N), P. glaucus 1(S), P. troilus 3(S), P. palamedes 60(S), Atalopedes campestris 2 (N), Polites vibex 2(N), Ancyloxypha numitor 1(N), Pyrgus oileus 36(S), Urbanus proteus 1(N), Epargyreus clarus 1(S). Total 34 spp., about 546 individuals. Field notes: More spp. and indiv. could have been counted had it not been for the worst mosquito infestation during any count to date.

Forman-Kleinpeter, LA. 30°22'N, 91°02'W. See 1977 report for complete locality and habitat description. 12 July 1981; 1015-1445 hrs; hazy in AM, partly cloudy to hazy in PM; 29.4-33.3°C; wind variable, 0-12.9 km/hr. One observer. Total party hours 4.5 (4 on foot, .5 by car); total party miles 4.5 (4 on foot). Observer: Michael L. Israel (1934 Oleander St, Baton Rouge, LA 70806). Conservation status; land uses; uniqueness; imminent threats: See 1977 report. Changes since last year: 5% more forest lost to building. Euptychia hermes 14(**), Lethe portlandia 1(C), Asterocampa celtis 9, A. clyton 5, Limenitis arthemis 2, L. archippus 4, Precis coenia 2, Phyciodes tharos 22, Polygonia interrogationis 2, Agraulis vanillae 8, Libytheana bachmanii 7, Calycopis cecrops 1, Strymon melinus 1, Phoebus sennae 21, Eurema lisa 6, E. nicippe 4, Papilio polyxenes 1, P. crestphontes 2, P. glaucus 4, Euphyes vestris 12, Atrytone delaware 1(C), Polites vibex 1, Hylephila phyleus 15, Copaeodes minima 3(N), Ancyloxypha numitor 2(N), Lerema accius 3(N), Pyrgus communis 6, Erynnis horatius 11, Epargyreus clarus 7. Total 30 spp., about 178 indiv. (** All species identified by sight unless otherwise noted.)

Lower East Pearl River, MS-LA. 30°21'N, 89°40'W. See 1977 report for complete locality and habitat description. 9 July 1981; 0900-1700 hrs; mostly clear all day; 28-35°C; wind SE, 4-6 km/hr. Three observers in one party. Total party hours 24 (3 on foot, 21 by car); total party miles 64 (1 on foot). Observers: Frank Ehret, Jr., Lance Ehret, Frank P. Fischer, Jr. (2720 Octavia St, New Orleans, LA 70115). Conservation status Land uses; Uniqueness; Imminent threats: See 1977 report. Changes since last year: Several bridges which make this area accessable by auto are in very bad repair and without work will soon fall. Cercyonis p. pegala 2(**), Euptychia hermes 1, E. cymele 1, Asterocampa clyton 3, Limenitis arthemis 22, L. archippus 13, Phyciodes tharos 7, Polygonia interrogationis 1, Vanessa atalanta 1, Papilio polyxenes asterius 2(C), P. cresphontes 3, P. glaucus 5, P. troilus 6, P. palamedes 1, Hylephila phyleus 12, Pyrgus communis 1, Erynnis horatius 1

(C), E. zarucco 17, Epargyreus clarus 4. Total 19 spp., about 103 individuals. (** All butterflies identified by sight unless otherwise noted - ed.)

Fort Belvior, VA. 38°41'N, 77°12'W. See 1978 report for full site description. 27 June 1981; 0800-1700 hrs; clear all day; 24-27°C; wind N, 0-13 km/hr. Seven observers in three parties. Total party hours 20 (18 on foot, 2 by car); total party miles 56 (20 on foot). Observers: Michael Bentzien, Steve Chambers, Suzanne DeBlois, Rick Grinberg, John H. Fales, Paul A. Opler (Office of Endangered Species, Washington, D.C., 20240), Tim C. Opler. Conservation status; land uses: 1700 acre county park, military reservation and preserve, several other natural parklands. Uniqueness: Freshwater marsh in Huntley Meadows. Imminent threats: Housing developments will continue to encroach, but area should still produce many species for years to come. Changes since last year: Several new townhouse developments destroyed some habitats counted last year. Hayfield previously very rich now plowed and converted to garden plots. Danaus plexippus 12(**), Cercyonis pegala 32, Euptychia cymela 10, Lethe appalachia 15, Asterocampa celtis 3, A. clyton 3, Limenitis astyanax 8, L. archippus 6, Precis coenia 7, Phyciodes tharos 319, Polygonia interrogationis 3, P. comma 2, Vanessa atalanta 9, V. virginiensis 34, Nymphalis antiopa 1, Euptoieta claudia 2, Speyeria cybele 95, Libytheana bachmanii 2, Harkenclenus titus 6, Satyrium calanus 5(C), Callophrys gryneus 3(C), Strymon melinus 19, Lycaena phlaeus 8, Celastrina argiolus 21, Everes comyntas 96, Colias philodice 22, C. eurytheme 46, Pieris rapae 119, Battus philenor 2, Papilio polyxenes 8, P. glaucus 38, P. troilus 28, Graphium marcellus 5, Euphyes dion 1(C), E. vestris 3(C), Poanes zabulon 3(C), Atrytone delaware 1, Atalopedes campestris 1, Pompeius verna 32, Wallengrenia egeremet 29(C), Polites coras 6, P. origenes 8(C), Hylephila phyleus 1(C), Ancyloxypha numitor 1, Nastra lherminier 3(C), Pholisora catullus 1, Erynnis horatius 20, E. baptisiae 1(C), Thorybes bathyllus 1(C), T. pylades 11, Achalarus lyciades 6, Epargyreus clarus 102. Total 52 spp., about 1223 indiv. Larvae seen: Pholisora catullus 2 (on Chenopodium album), Staphylus hayhursti 7 (on C. album), P. polyxenes 6 (on Dill), P. rapae 2 (on Brassica rapa), E. clarus 1 (on Robinia pseudacacia). Field notes: Ideal clear weather and low humidity made for new high count for area. Hairstreaks were very rare this year compared to last. This year was good for southern migrants (E. claudia, H. phyleus, P. coenia). Colony of E. dion discovered in fresh water marsh in Huntley Meadows. (New northern record for Cyllopsis gemma later in the year.) Good sublocalities not counted before were located in the Mason Neck and Marshall Hall areas. More than 80 spp. have been found in count area at all times of year, and with more parties on count day, 60 spp. might be found in some future year. (** All species ID's by sight unless otherwise indicated - ed.)

ZONE 7: NORTHEAST
(Connecticut, Maine, Maryland,
New Jersey, New York, Pennsylvania)

Southern New Haven County, CT. 41°20'N, 72°58'W, center jct Routes 10 and 15 in Hamden. See earlier reports for habitat description. 9 July 1980; 1145-1630 hrs; hazy in AM to partly cloudy in PM; temp and wind not indicated. Two observers in one party. Total party hours 4.75 (4 on foot, .75 by car); total party miles 28 (3 on foot). Observers: Larry Gall (Dept. Biology, 257 OML, Yale University, New Haven, CT 06520), Dale Schweitzer. Conservation status; land uses; uniqueness: See earlier reports. Imminent threats: Construction of houses continues to near edge of pond along Rt 67 in productive count area. Unclear at present whether development plans include future filling of pond (Gall has written to Woodbridge Wetlands Commission in an attempt to discover status of land). Changes since last year: Shrubs and weeds in gasline right-of-way were disced this spring opening up habitat to marsh-wetland species once again. West Rock entrance roads are now blocked off with foot access now the only way into the preserve. Danaus plexippus 1(S), Cercyonis pegala 14 (S), Euptychia cymela 14(N), Lethe portlandia anthedon 1(S), Asterocampa celtis 9(N), Limenitis astyanax 2(S), L. archippus 1(S), Phyciodes tharos 2(N), Chlosyne nycteis 18(N), Euphydryas phaeton 2(N), Polygonia interrogationis 2(S), P. comma 1(C), Vanessa atalanta 1(S), Nymphalis antiopa 35(S), Harkenclenus titus 6(C), Satyrium liparops 5(C), S. calanus 91(C), S. caryaevorum 23(C), S. edwardsii 41(N), S. acadica 25+(C), Callophrys gryneus 1(S), Strymon melinus 1(C), Lycaena phlaeas 4(S), Celastrina argiolus 1(S), Everes comyntas 8(N), Colias philodice 14(S), C. eurytheme 3(S), Pieris rapae 37(S), Papilio glaucus 9(S), Euphyes conspicua 37(C), E. vestris 2(N), Poanes massasoit 2(S), Atrytone logan 7(C), Pompeius verna 8(N), Wallengrenia otho 10(N), Polites coras 1(S) P. origenes 3(N), P. mystica 1(S), Thymelicus lineola 7(S), Ancyloxypha numitor 3(S), Pholisora catullus 1(N), Thorybes bathyllus 1(N), Epargyreus clarus 9(N). Total 44 spp., about 470+ indiv. Larvae seen: D. plexippus 4 (on Asclepias syriaca). Field notes: This has been a boom year for most spp. of Lepidoptera in the New Haven area, including Lymantria dispar (gypsy moth) which has been defoliating locally. Our count this year is the highest ever, although we missed at least seven common spp. we expected to see at this time. Notable for their absence were L. appalachia in the Carex woodland marsh, T. pylades and Vanessa sp. We also spent less time in the Carex marsh areas so E. conspicua and P. massasoit may be underrepresented. P. nycteis was way past peak (some indiv. were seen as early as 28 May by Gall). Gall has been looking for S. caryaevorum in the New Haven area for 6 yrs with no success until this year. It was the seventh most common butterfly despite never having been recorded in any previous count. Associated with the population expansion fo this butterfly was a noticable 'flush' of variability. (S. caryaevorum probably would have been our second most abundant butterfly had we realized its preferred nectar source, Cornus sp.).

Southern New Haven County, CT. 41°20'N, 72°58'W, center Jct Routes 10 and 15 in Hamden. See earlier reports for habitat description. 6-7 July 1981; 1100-1430 and 0915-1100 hrs; clear all day; temp. not indicated; wind W to SW, variable. Two observers in one party. Total party hours 5.25 (4 on foot, 1.25 by car); total party miles 28 (4 on foot). Observers: Larry Gall (Dept. Biology, 257 OML, Yale University, New Haven, CT 06520), Dale Schweitzer. Conservation status; land uses; uniqueness; imminent threats: See earlier reports. Changes since last year: None. Danaus plexippus 3(S), Cercyonis pegala 99(N), Euptychia cymela 32(C), Lethe portlandia anthedon 2(S), L. appalachia 4(C), Asterocampa celtis 2(S), A. clyton 1(S), Limenitis astyanax 2(C), L. archippus 2(S), Phyciodes tharos 13(N), Chlosyne nycteis 21(N), Euphydryas phaeton 17(N), Polygonia interrogationis 23(C), P. comma 2 (C), Vanessa atalanta 10(N), V. cardui 1(C), V. virginiensis 15(N), Nymphalis vau-album 2(N), N. antiopa 28(C), Euptoieta claudia 1(S), Speyeria cybele 17(N), Bolloria bellona 1(S), Harkenclenus titus 8(N), Satyrium liparops 2(C), S. calanus 28(C), S. caryaevorum 23(C), S. edwardsii 4(C), S. acadica 25(C), Callophrys gryneus 5(C), Strymon melinus 2(S), Lycaena phlaeas 24(C), Celastrina argiolus 7(N), Everes comyntas 6(N), Colias philodice 21(S), C. eurytheme 64+(S), Pieris rapae 132+(S), Papilio polyxenes 6(N), P. glaucus 6(S), Euphyes conspicua 105+(C), E. vestris 3(N), Poanes massasoit 25(N), P. hobomok 1(N), Atrytone logan 18(N), Pompeius verna 17(N), Wallengrenia otho 60(N), Polites coras 2(S), P. themistocles 2(C), P. origenes 8(C), P. mystic 2(N), Thymelicus lineola 29(N), Ancyloxypha numitor 3(S), Pholisora catullus 14(N), Thorybes pylades 1(S), Achalarus lyciades 8(S), Epargyreus clarus 26(S). Total 55 spp., about 996+ individuals. Larvae seen: D. plexippus 1 (on Asclepias syriaca), P. interrogationis 1 (on Alnus sp.). Butterflies in copula: P. rapae (at 1322 hrs), S. liparops (at 1230 hrs), C. pegala 2 (at 1041 and 1325 hrs). Field notes: A most remarkable year (even better than 1980) for diurnal Lepidoptera, esp. migrants. The Nymphalids were way up, with huge emergences of Polygonia and Nymphalis in early July. This year we checked a bait trail which may partially account for Nymphalid abundance. Of unusual note were the E. claudia and A. clyton; both observers were close enough to confirm ID's. Neither of us in our combined 15 yrs of CT collecting experience had seen clyton or claudia before although a number of records do exist for the state. Also of note was 1981's status as the peak year in the current gypsy moth (Lymantria dispar) defoliation cycle in southern CT. West Rock ridge, one of our principle sites, was essentially stripped bare of oak and many hickories, elms and others.by the second week of June. Quercus ilicifolia and Q. stellata were hit extremely early (May) with other oaks following soon after. Outright starvation (from gypsy mediated defoliation) and increased parasitism (also mediated by gypsies) are clearly responsible for the precipitous decline in S. edwardsii (whose food plant is Q. ilicifolia). E. conspicua and C. pegala way up this year though P. rapae remains the most common butterfly seen.

Islesboro, Waldo Co, ME. 44°21'N, 68°54'W, includes island of Islesboro, N from Ryder's Cove (2.25x3.25 mi). Elev: 6-60 m. Habitat coverage: Wood roads; meadows; old fields; over-grown gravel pits. 27 June 1981 0910-1510, 1615-1715 hrs; clear in AM to mostly clear in PM; 21.1-24.4°C; wind SW, 0-15 km/hr. 4.25 observers in one party. Total party hours 5.5 (5 on foot .5 by car + lunch); total party miles 6+(?) (can't guess, we amble!, 6 by car). Observers: Heather Baker, Joan Baker, Jo Brewer, Alva Sanborn (.25), Dave Winter (257 Common St, Dedham, MA 02026). Conservation status; Land uses: See habitat coverage. Uniqueness: Not unique, except for general lack of interference by man. Imminent threats: None, Changes since last year: None. Danaus plexippus 6(S), Euptychia cymele 10 (**), Lethe eurydice 1(C), Limenitis archippus 10, L. arthemis 8(C), Phyciodes tharos 60+, Chlosyne harrisi 24, Polygonia interrogationis 6, Vanessa atalanta 75+, Nymphalis antiopa 15(S), Euptoieta claudia 1(C), Speyeria cybele 7, S. atlantis 6, Boloria selene 1(C), Calephelis virginiensis 15, Lycaena phlaeas americana 50+(S), Celastrina argiolus 12, Colias interior 30, C. eurytheme 1(C), Pieris rapae 12, Papilio glaucus 18(S), Euphyes vestris 2(C), Poanes hobomok 5, Polites coras 16, P. mystic 25+, P. themistocles 25+, Ancyloxypha numitor 2(C). Total 27 spp., about450+ individuals. Larvae seen: D. plexippus 5 (on Asclepias syriaca); L. archippus 2 (on Salix sp.); P. interrogationis 7 (on Hops); N. antiopa 40+ (on Pussy Willow); C. virginiensis 7 (on Pearly Everlasting). Field notes: N. vau-album seen on 26 June. 51 V. atalanta taken in 4 bait traps on 24 June. It is interesting, with regard to E. claudia, that within 24 hrs of its capture I took in a Robinson nercury vapor trap 6 Magusa orbifera and 1 Spodoptera ornithogalli, both southern migrants seen occasionally in September, suggesting a recent strong southerly air flow. (** Denotes butterflies ID'd by by both sight and capture, all others as noted - ed.)

Calvert Co., MD. 35°37'N, 76°39'W. See 1976 report for complete habitat description. 12 July 1981; 0800-1600 hrs; AM was cloudy, clear in PM; 24-35°C; wind SE, 0-8 km/hr. Four observers in two parties. Total party hours 16 (11.75 on foot, 4.25 by car); total party miles 85 (11 on foot). Observers: Laura Adrian, John H. Fales (2809 Ridge Rd, Huntingtown, MD 20639), Trish Higgins, Paul A. Opler. Conservation status; land uses; uniqueness; imminent threats: See 1976 report. Changes since last year: New housing has been erected. Danaus plexippus 13**, Cercyonis pegala alope 3, Euptychia cymela 9, Lethe appalachia 2, Limenitis astyanax 1(C), L. archippus 6, Precis coenia 18(C), Phyciodes tharos 69, Polygonia interrogationis 7(C), Vanessa atalanta 9, V. virginiensis 44(C), Nymphalis antiopa 3, Euptoieta claudia 36(C), Speyeria cybele 43, Libytheana bachmanii 2(C), Callophrys gryneus 36(C), Calycopis cecrops 3, Strymon melinus 13, Lycaena phlaeas 2(C), Celastrina argiolus 4(C), Everes comyntas 94(C), Colias philodice 99, C. eurytheme 123, Eurema lisa 5(C), Pieris protodice 1(C), P. rapae 700+, Battus philenor 1, Papilio polyxenes 17, P. glaucus 34(C), P. troilus 17(C), Graphium marcellus 34(C), Euphyes vestris 5(C), Poanes viator 21(C), Atalopedes campestris 178(C), Hylephila phyleus 1(C), Ancyloxypha numitor 93, Pholisora catullus 42(C), Erynnis horatius 13(C), Staphylus hayhurstii 2, Thorybes bathyllus 1, Epargyreus clarus 86. Total 41 spp., about 1892+ indivduals. Larvae seen: V. virginiensis 1. Field notes: The ground was dry. The week predeading the count was marked by very high daily temps between 33° and 39°C. The most common nectaring plants were Indian Hemp, Asclepias sp., Queen Anne's Lace and Red Clover. (** All butterflied identified by sight unless otherwise noted - ed.)

Galloway Twp., NJ. 39°29'N, 74°33.5'W, center intersection of Duerer St (Rt 561) and Pomona Port, includes Republic Rd (Rt 575), Galloway Twp, Port Republic, Egg Harbor City, Egg Harbor Twp, Absecon, Pleasantville, Stockton State College, Brigantine Nat'l Wildlife Refuge. Elev: 0-22 m. Habitat coverage: Oak pine 25%, pine oak 20%, saltmarsh 20%, agriculure, urban, old field 15%, hardwood swamp 10%, pitch pine lowland 8% white cedar and other wetlands 3%. 3 July 1981; 1048-1545 hrs; mostly cloudy all day; 21.1-24.4°C; wind E, 0-11.4 km/hr. Two observers in one party. Total party hours 5 (all on foot); total party miles 3.5. Observers: William J. Cromartie (NAMS, Stockton State College, Pomona, NJ 08240), Michael O'Brian. Conservation status; land uses: Stockton State College - some recreation, research. Goose Ponds - private conserve. Brigantine N.W.R. - Wildlife refuge. Other private lands. Uniqueness: Goose Ponds and Oceanville Bog contain endangered (in New Jersey) plant species. Imminent threats: Brigantine NWR and Oceanville Bog are adjacent to large planned unit devlopments. Goose Pond unlawfully used to receive drainage from adjacent lands which are being developed. Changes since last year: None. Danaus plexippus 3(S), Cercyonis pegala 6(N), Euptychia cymela 20(N), Limenitis astyanax 1(S), Precis coenia 2(S), Phyciodes tharos 95(S), Polygonia interrogationis 1(S), Vanessa virginiensis 1(S), Satyrium liparops 1(S), S. calanus 4(N), Strymon melinus 2(S), Lycaena phlaeas 6(S), Everes comyntas 45(N), Colias eurytheme 23(S), Pieris rapae 11(S), Papilio troilus 2(S), Erynnis juvenalis 3(S), Epargyreus clarus 1(S). Total 19 spp., about 234 individuals. Larvae seen: P. coenia 4 (on Rubus), P. troilus 1 (on Sassafras albidum), E. clarus 1 (on Robinia).

Galloway Twp., NJ. See preceeding report for locality information. Habitat coverage: Open grass/segde bog 33%, young cedar bog 33%, lake and fresh water marsh 17%, hardwood swamp 5%, pine/oak upland 5%, saltmarsh 3%, pitch pine lowland 3%. 5 July 1981; 1050-1435 hrs; mostly cloudy in AM to mostly cloudy with intermittent light rain in PM; 21-26°C; wind SW, 10-24 km/hr. Two observers in one party. Total party hours 2.5 (all on foot); total party miles 1. Observers: William J. Cromartie (NAMS - Stockton State College, Pomona, NJ 08240), John Gallegos. Conservation status; land uses; uniqueness; imminent threats; changes since last year: See preceeding report. Danaus plexippus 1(S), Phyciodes tharos 4(S), Nymphalis antiopa 1(S), Celastrina argiolus 6(S), Everes comyntas 1(S), Pieris rapae 5(S), Panoquina panoquin 6(C), Poanes massasoit 23(C), P. viator 1(C), Epargyreus clarus 5(S). Total 10 spp., about 53 indiv. Field notes: 23 P. massasoit included 2 form suffusa. No butterflies seen at Goose Ponds except 1 N. antiopa in adjacent pitch pine lowland.

Greenbrook Sanctuary, NJ. 40°50'N, 74°W, center 1 mi N of Clinton Ave, Tenafly. Elev: 90-140 m. Habitat coverage: 35% roadside, 30% pond border, 25% open oak woods with hackberry, 10% meadow. 11 July 1981; 0945-1700 hrs; clear all day; 26.5-33.3°C; winds not noted. One observer. Total party hours 5 (all on foot); total party miles 3. Observer: John Serrao (311 Hudson Ave, Tenafly, NJ). Conservation status, land uses: Nature preserve. Uniqueness: Small sphagnum bog. Imminent threats: None. Changes since last year: More Asclepias sp. Danaus plexippus 1, Cercyonis pegala 20, Euptychia cymela 3, Lethe portlandia 2, Asterocampa celtis 1, A. clyton 1, Phyciodes tharos 3, Polygonia interrogationis 1, Vanessa atalanta 6, V. virginiensis 2, Nymphalis antiopa 2, Speyeria cybele 2, Harkenclenus titus 1, Satyrium calanus 2, Lycaena phlaes 12, Celastrina argiolus 4, Colias philodice 1, Pieris rapae 50, Battus philenor 2, Papilio glaucus 5, Wallengrenia otto 4(N), Xenophanes trixus 3(N), Achalarus lyciades 8, Epargyreus clarus 3. Total 24 spp., about 147 indiv. Larvae seen: D. plexippus 5(on Asclepias sp.), P. comma 5 (on Tall Nettle), V. cardui 6(on Tall Nettle). (** All ID's by sight unless otherwise noted - ed.)

Inwood Hill Park, Manhattan, NY. 40°52'N, 73°55'W, center Inwood Hill Park, includes E to Broadway, N to Spuyten Duyvil Creek (AKA Harlem River), W to Hudson River, S to Dyckman St. See 1980 report for further habitat description. 29 June 1981; 1100-1900 hrs; clear all day; 29-33°C; winds W, 0-10 km/hr. One observer. Total party hours 8 (all on foot); total party miles 2. Observer: Jeffrey Stuart Ingraham (55 8th Avenue, Brooklyn, NY 11217). See 1980 report for conservation status, land uses, uniqueness and threats to habitats. Changes since last year: Effects of drought and forest fires (see field notes). Danaus plexippus 4(N), Euptychia cymela common(N), Asterocampa celtis common(S), A. clyton 2(S), Phyciodes tharos 3(C), Chlosyne nycteis common (C), Polygonia interrogationis 6(C), P. comma 4(C), Vanessa atalanta 6(C), V. cardui 1(C), V. virginiensis 2(C), Nymphalis antiopa 12(C) Speyeria cybele 2(C), Harkenclenus titus 8(C), Satyrium liparops 2(C), S. calanus common(C), S. caryaevorus common(C), Lycaena phlaeas americana 1(C), Celastrina argiolus common (C), Everes comyntas common(C), Colias philodice 3(C), C. eurytheme 2(C), Pieris rapae common(N), Papilio glaucus 10+ (C), P. polyxenes asterius 4(C), P. troilus 2(C), Poanes hobomok 3(N), Pompeius verna 9(C), Wallengrenia egermet common (C), Thymelicus lineola 4(N), Ancyloxypha numitor 2(C), Pho-

ATALA

Volume 9, Nos. 1 & 2, 1981(84)

THE XERCES SOCIETY

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Published [illegible] Los Angeles, California, U.S.A. [illegible] by the Xerces Society [illegible]

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ATALA

JOURNAL OF THE XERCES SOCIETY

Volume 9 **1981(84)** **Numbers 1 & 2**

Introduction

Symposium on the Biology and Conservation of Monarch Butterflies

Robert Michael Pyle

Conservation Monitoring Centre, 219c Huntingdon Road, Cambridge, England[1]

This occasion marks the first joint meeting of the Lepidopterists' Society and the Sociedad Mexicana de Lepidopterologia, as these neighbor organizations of parallel interest gather together at Cocoyoc, Morelos, Mexico. Perhaps no other single subject arouses such common enthusiasm between the two groups as the fate of the overwintering colonies of migratory Monarch butterflies, both in Mexico and Alta California. Therefore, it was felt that this historic meeting would provide a perfect opportunity for a symposium on the topic of La Monarca, its biology and conservation. The Xerces Society offered to publish the proceedings of the Cocoyoc conference as a special Spanish/English double issue of ATALA.

No attempt is made in this volume to essay the entire field of knowledge about *Danaus plexippus*. This would be beyond our capacity and constitute a major volume. The reader is referred to many other papers, articles and books cited in the following studies, for further information. In particular, both the popular and scientific works of Professors F. A. Urquhart and L. P. Brower will furnish historical perspective and depth to this fascinating and complex topic.

Rather, it has been our intention to provide a platform for a number of original contributions—both scientific papers and reflective essays—bearing upon our understanding and stewardship of Monarchs. Several of the persons most intimately involved in *Danaus* studies and management on both sides of the border have contributed their thoughts, and they are to be thanked for giving the symposium its substance. We are not able to reproduce the extensive and valuable discussions that followed the presentation of these papers at Cocoyoc. However, we trust that it has found its way into the broader debate and the decision-making process. In the same way, we are hopeful that this issue will arouse further thought, comment and questioning, all of which can only redound to the benefit of the phenomena we are all earnestly trying to protect and preserve.

In particular, we wish to thank the honored representatives of the federal government and the State of Michoacan who are with us in Cocoyoc: Ing. Juan Jose Reyes Rodriguez, Director of the Department of Wildlife Management, SARH; and Ing. Alberto Cruz, Chief of Forestry of the State of Michoacan and personal representative of the Hon. Governor Cuauhtemoc Cardenas. In addition, all of our friends and colleagues who have taken their time to attend this symposium, to contribute to it and to help make it a success, are to be warmly thanked. I wish to extend my personal gratitude to the program committee, the officers and executive boards of both societies, and the lepidopterists who have enabled this meeting to take place, including our excellent interpreters. All of you will bear credit for whatever may be accomplished in the field of Monarch conservation.

Production of this issue of ATALA has taken an unfortunately long time, and many changes have occurred in the meantime. This situation is complicated, it will not stand still. A new government has taken office in Mexico, with consequent changes in offices and the personnel attending them. Please take this into account while reading and using this document. While we regret being unable to mention by name all of the former and present officials helpful to the symposium and the conservation effort, we wish to take this opportunity to salute and thank them for their good will, dedication and commitment to a rich resource future for Mexico and the continent. It is the great hope of everyone at Cocoyoc, and everyone who loves Monarchs, that these butterflies in all their number and glory will remain forever a part of that future.

Cocoyoc, August 1981
and
Gray's River, August 1983

[1]Current address: Swede Park, 369 Loop Road, Gray's River, Washington 98621 USA

Articles

Monarch Butterfly Conservation: Interactions of Cold Weather, Forest Thinning and Storms on the Survival of Overwintering Monarch Butterflies (*Danaus plexippus* L.) in Mexico

William H. Calvert
Willow Zuchowski
Lincoln P. Brower

Department of Zoology, University of Florida, Gainesville, FL 32611, U.S.A.

Prologue

The monarch butterfly overwintering phenomenon in Mexico is one of the finest zoological spectacles in the world and represents an international treasure comparable esthetically to the great works of art and zoologically to the magnificent herds of mammals on the plains of East Africa. The joint and memorable meeting of the Mexican and International Lepidopterist's Societies at Cocoyoc, Morelos, Mexico in August, 1981 emphasized the necessity for immediate action that must be taken to develop major plans of habitat preservation to assure the integrity of the forest in the overwintering valleys of this marvelous butterfly. Without this action, the migratory phenomenon will be endangered. Following the many press and TV releases in the United States, Japan and Mexico, it has also become increasingly urgent to develop a plan of regulated visitation to the colonies because of the vulnerability of the dormant butterflies during their wintering period.

What follows is a brief summary of three recent research studies carried out by the authors with support from the World Wildlife Fund and the National Science Foundation. These studies provide scientific documentation of the grave and mounting threat to the overwintering butterflies consequent upon the increasing pressure of forest utilization.

The monarch butterfly (*Danaus plexippus* L.) overwinters in high altitude coniferous forests of Mexico's transvolcanic belt which are dominated by the oyamel fir, *Abies religiosa* H.B.K. (Urquhart and Urquhart, 1976; Brower, Calvert, Hedrick and Christian, 1977). Butterflies form roosting clusters on branches and trunks beneath the forest canopy in numbers estimated to be in the tens of millions. When forming colonies, the butterflies conspicuously avoid clearings and areas radically thinned by logging where the moderating effect of the canopy on temperature extremes is reduced (Calvert and Brower, in press).

In the states of Mexico and Michoacan where the butterflies overwinter, government controlled forest management is practiced and includes selective marking and removal of trees on both communal and private property. There is little waste; large trunk sections are used for saw logs, intermediate sections are used for pulp and branches and tops for firewood by the local population. When trees are removed, growth of those remaining is enhanced. However, since 1976, the level of exploitation has dramatically increased near Site Alpha, the most extensive overwintering area (Figs. 1 & 2), and at one site in the 1978-79 overwintering season a heavy logging operation was carried out in the midst of a major colony (Fig. 3).

We do not know whether butterfly behavior is flexible enough for them to shift their overwintering locations if their prime area is made ecologically unsuitable by lumbering. Furthermore, since we had previously observed large accumulations of butterflies apparently killed by inclement cold weather (Calvert, Hedrick and Brower, 1979), questions were raised concerning the degree of protection afforded by undisturbed forests and how thinning effects the forest's ability to dampen weather extremes. We, therefore, initiated this study to investigate the effects of cold weather on butterfly survivorship and of forest thinning on microclimate in these high altitude forests.

The Effect of Cold Weather on Monarch Survivorship

A rather pronounced behavior is exhibited by monarch butterflies in response to being dislodged from their roosting clusters. As soon as temperatures permit (around 3°C) they crawl up onto any nearby vegetation, which suggests that it is a disadvantage for a butterfly to be on the ground. Measurement of temperatures at 25 cm intervals from 0-2 m height above the ground confirmed that the coldest temperatures were those near the ground (Calvert and Brower, in press; also see Geiger, 1965). In January, 1980 we conducted an experiment which indicated that naturally occurring ground temperatures killed or impaired the flight of butterflies exposed only one night on the ground in clear areas while butterflies similarly exposed under the forest canopy suffered no damage (Calvert and Brower, in press). Temperature differences between forest and clearing averaged 3.54°C (range -2.2°C clearing to 2.8°C colony). In addition to the colder temperatures, butterflies exposed in the clearing were also subjected to heavier dew fall.

Figs. 1 & 2. Massive logging operations carried out during the 1980-81 overwintering season within 2 km of major butterfly colonies.

Fig. 3. Tens of thousands of clustered butterflies were killed by falling trunks and branches of trees felled in the midst of an overwintering colony during the 1978-79 overwintering season.

The evidence suggests that the coating and subsequent freezing of dew water on the exoskelton is a significant factor in their death or impairment. Due to the process of inoculative freezing where external ice crystals grow through the exoskeleton and initiate freezing within, these insects are damaged at higher temperatures than they would be if dew water were not present (Calvert and Brower, in press; see also Salt, 1936, 1963).

The Influence of Forest Foliage on Temperature

Forest foliage dampens extreme temperatures occurring in nearby clearings by retarding the escape of radiation to the atmosphere or cosmic cold. Radiation from objects under the canopy is absorbed and reradiated to other objects, usually plant foliage. In contrast, radiation from objects in clearings or at the canopy-sky interface escapes almost unhindered to the atmosphere and cosmic cold, because no plant foliage lies above to absorb and reradiate radiation. Forest foliage was so effective in retarding the escape of nighttime radiation that the effect of a single tree was felt 4 m out into a clearing (Fig. 4). Temperature records taken along a transect from a tree out into a clearing showed ground temperatures under the thickest foliage 2 m from the trunk to be over 5°C warmer than those in the center of the clearing 12 m away. Temperatures declined but were generally warmer than the clearing center out to 8 m, 4 m beyond the edge of the tree crown (Calvert, Zuchowski and Brower, in press*b*). The rise in temperature at meter 10 (Fig. 4) is explained by the absorption and reradiation of heat by an isolated clump of herbaceous plants.

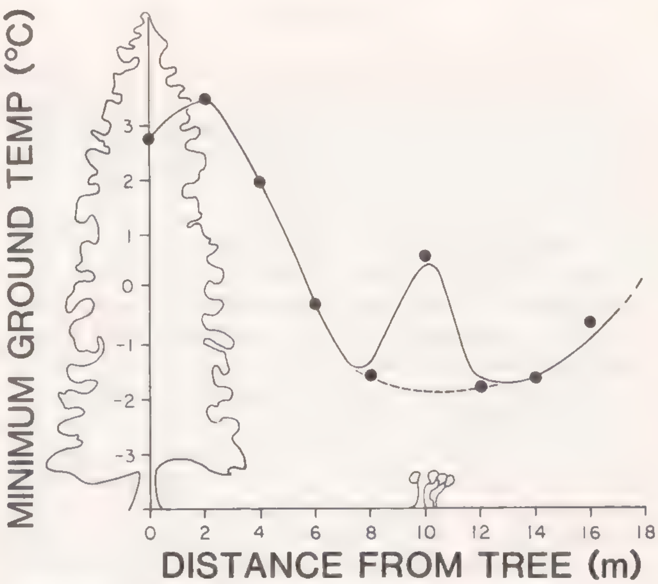

Fig. 4. The effect of isolated vegetation in moderating nighttime ground temperatures in a high altitude coniferous forest clearing. The tree is *Abies religiosa*; the small clump of vegetation is *Penstemon gentianoides*.

The Effect of Forest Thinning on Microclimate

The ability of forests of different densities to retain heat accumulated by day was investigated by comparing minimum night temperatures of radically with moderately thinned plots adjacent to each other at two forest locations (Table 1a; Calvert et al., in press*b*). All plots had been lumbered and the radically thinned plots had densities typical of recently lumbered forests near the colony. Ignoring for the moment replicate 2 at Mojonera Alta, an average density difference of 797 trees/ha results in an average minimum temperature difference of 2.92°C or a loss of 0.37°C for each 100 trees/ha density decline. At Aserradero, an average density difference of 465 trees/ha

results in an average temperature difference of 2.45°C or 0.53°C per 100 trees/ha density decline. The absence of a temperature difference at Mojonera Alta on March 8th is explained by the presence of dense fog in the area which is similar in effect to foliage in retarding radiation loss to the night sky (Geiger, 1965).

A temperature/density relationship was also established for the colony and for a location where a colony had existed earlier in the eason (Table 1b). Using multiple linear regression techniques, the combined data of Tables 1a and 1b were analyzed for a relationship between minimum temperature and three predictors, forest density, altitude and date. All three predictors were highly significant ($p<0.001$) and the model explained 92% of the variation.

The 1980-81 Site Alpha butterfly colony formed in a forest containing approximately 400 trees/ha. If the colony were thinned to the 150 trees/ha (typical of nearby lumbered areas) an expected minimum temperature can be predicted using the computer generated regression equation:

$$\text{Minimum Temperature} = 63.8140 + 0.0047(\text{density}) + 0.1061(\text{date}) - 0.0217(\text{altitude})$$

A change in density of 250 trees/ha (400 trees/ha - 150 trees/ha) is thus expected to lower the minimum nighttime temperature 1.19°C (Calvert et al., in press*b*).

Table 1. Relationship between nightly minimum temperature and forest density.

Replicate	Location	No. of Stations	Date	Altitude	Forest Density	Average Min. Temp (°C)	Temperature Difference	Conditions
a. Direct comparison of radically thinned and moderately thinned forests								
1	Mojonera Alta	7	Feb 8	3283	279	-1.37		
							2.92	Clear
		8			1076	1.55		
2	Mojonera Alta	8	Mar 8		197	3 75		
							0.03	Fog
		8			1039	3.72		
1	Aserradero	7	Feb. 24	3266	131	-0.92		
							2.45	Clear
		8			513	1.53		
2	Aserradero	8	Mar. 14		105	0.69		
							2 45	Clear
		8			653	3 14		
b. In forests occupied by colony and remnant colony								
1	Colony	10	Jan. 23*	3138	399	-1.04		
2	Colony	9	Feb. 11*		371	2.00		
3	Colony	8	Mar. 2*		371**	4.29		
1	Remnant colony	8	Feb. 7	3120	731	3 86		Clear

*Middle dates for a 6 and two 7-day temperature record periods, respectively
**Same transect as above

The Effect of a Severe Storm on Butterfly Survivorship

There are two principal causes of mortality of overwintering monarch butterflies: predation (by several species of birds [Calvert et al., 1979; Fink and Brower, 1981], and mice [Horner, Moffitt, and Brower, in prep.]) and cold weather associated with occasional winter storms that impact the area with rain, hail and snow (Calvert and Brower, in press). Previously we had observed accumulations of undamaged butterflies up to 15 cm deep beneath trees within dense roosting clusters (Fig. 5). Because they showed no sign of predation or disease, we assumed that they had been killed by inclement weather, but until January 1981 we had never directly observed the effect of severe winter weather on the butterfly colony.

On January 13, 1981, a ten day period of unusually severe inclement weather occurred throughout a large area of the central highlands of the states of Michoacan and Mexico. The storm began with moderately cold temperatures and daily rain and hail that soaked both branches and butterfly clusters (Fig. 6). Three days of snowfall followed which further loaded

Fig. 5. Accumulations of dead butterflies beneath roosting trees, March 1978. Dead butterflies in center of photo are 15 cm deep.

Fig. 6. Bough clusters soaked by rain and snow from a winter storm, January 1981.

already rain-soaked and butterfly-laden branches causing many to break and fall (Fig. 7). Some of the roosting butterflies brought down were injured directly by the fall; others were strewn onto the snow only to be buried by subsequent snowfall (Fig. 8). A two-day period of partly cloudy skies and sub-zero night and morning temperatures followed. Butterflies buried in or partially buried in the snow were trapped there because the surface of the snow froze. A second major snowfall added more wet snow to already soaked branches causing many additional ones to break, and in several instances, tops of small trees also broke off and fell. The storm ended abruptly during the early morning of January 24th when the sky cleared completely. Enhanced by radiational cooling, temperatures plummeted to an average low of -4.08°C in the colony with minimum reading of -5°C at some locations.

Fig. 7. Small tree that fell due to the weight of butterflies and snow, January 1981.

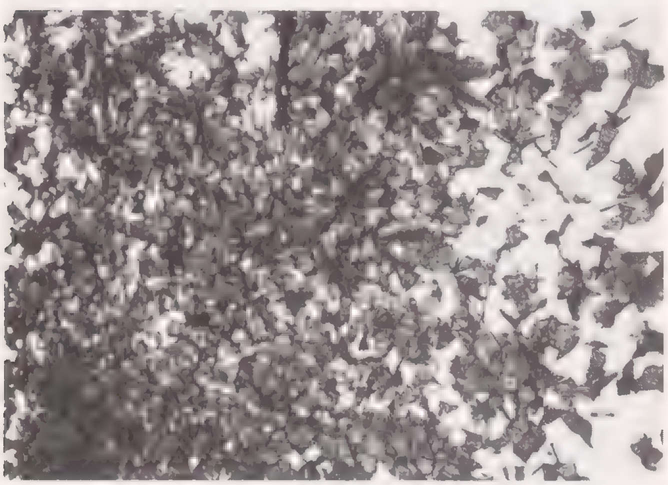

Fig. 8. Live and dead butterflies that fell from clusters onto snow, January 1981. Many of these were buried by a subsequent snowfall.

Butterflies fell or were dislodged from their clusters during the entire storm period and continued to fall for weeks afterward. The cold morning of January 24th markedly affected both the number falling per unit time and their trajectory. Prior to this date their trajectory of fall resembled uncontrolled flight—a half fall and half glide groundward. On January 24th and for several days afterward most butterflies plummeted straight to the ground like inanimate objects. The number falling increased dramatically for several days and on January 26th a phenomenal 88.4 butterflies fell per m^2 per hour whereas only 1.1 fell per m^2 per hour during a comparable time and location before January 24th (Calvert el al., in press*a*).

The general effects of the storm and in particular of the cold morning were assessed by flight testing butterflies taken from four locations within a colony during and after the storm. Butterflies were classified as dead, moribund, flight impaired or normal depending on their flight performance. Normal butterflies accumulated on the ground during the storm, but rapidly removed themselves, mainly by crawling up onto low vegetation (Fig. 9). (Prevailing cold weather prevented them from flying to the clusters). Correspondingly, dead butterflies accumulated on the ground very rapidly at first, then more slowly until their proportion reached 94% six weeks after the storm began. In the morning of January 2th cold temperatures penetrated into the tree crowns killing butterflies in their roosts causing them to fall directly to the ground when dislodged. Killing cold temperatures also froze butterflies that had crawled up onto low foliage, a behavior that we had previously found effective in preventing mortality (Calvert and Brower, in press).

The total number killed per m^2 was estimated each month of the 1980-81 overwintering season by periodic sampling of grounded dead butterflies that showed no disease or predation damage. An estimate of the total number killed by the storm

Fig. 9. Grounded butterflies that have crawled up onto low vegetation to remove themselves from colder temperatures near the ground, January 1977. Air temperatures were too cold for the butterflies to fly back to their roosts.

was obtained by multiplying these figures by the colony area and subtracting the estimate before the storm from that after it. Approximately 2.5 million butterflies were killed by the storm and cold which wreaked more destruction than any whose effects we had observed in our 5 years experience at the overwintering colony.

Conclusion

It is clear from the foregoing experiments that dew-wetted butterflies are killed at temperatures beginning at a few degrees below freezing. Largely because of the action of foliage in retarding radiational loss at night, colony temperatures normally do not fall this low. When occasional winter storms impact the area bringing in moisture in the form of rain, hail and snow and low temperatures in the lethal range wetted butterflies die by the millions.

Thinning the forests reduces the forest's ability to retard the escape of radiation at night. Therefore temperatures in thinned forests are expected to fall even lower. Since during critical storm periods, temperatures are already at killing threshold, thinning the forest is expected to cause the death by freezing of more thousands, perhaps even millions of butterflies.

In light of our investigations, it is imperative that a core area for the overwintering butterflies be set aside where no lumbering is permitted in order to allow the forest to exert its fullest influence in dampening weather extremes and thereby provide the fullest possible protection to the colony.

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The Monarch Butterfly as a Resource for Ecological Research in Mexico

Leonila Vázquez G.
Héctor Perez R.

Institute of Biology, Department of Zoology, National Autonomous, University of Mexico

Since 1976, as a consequence of Dr. F. A. Urquhart's publication of the Monarch butterfly's overwintering area in Mexico, the species has been much discussed for the most fantastic migration known in the animal kingdom, for the enormous number of individuals that participate in these migratory flights (approximately 15.25 million at one of the overwintering sites, according to Brower, 1977), and for the spectacle it offers to tourists. The most significant aspect of the phenomenon combines these and other features; it is the role played by the species as a biological component of an ecosystem. In this regard, the Monarch's importance is not yet fully understood.

The interest awakened at a national and international level by the discovery of the overwintering sites has stimulated an avalanche of visitors, beginning with the first year after the initial discovery. The visitors' very enthusiasm, together with their ignorance of the butterflies' delicate nature, constitute a danger to the species' existence, quite apart from the damage tourists inflict on vegetation by preparing camp or picnic sites. Such damage, nevertheless, cannot be compared to that caused by lumbering. Over the course of the past several years, we have observed that some sites are left with large cleared areas in addition to natural forest clearings. This undoubtedly alters normal environmental conditions, thus greatly prejudicing the establishment of butterfly colonies.

The special concern shown by the Biology Institute of the National Autonomous University of Mexico (UNAM), as well as other national and international institutions, culminated in the issuance of a decree by the president of Mexico, published in the Official Daily in April of 1980, declaring "places where the butterfly known as the 'Monarch' overwinters and reproduces to be reserve areas and wildlife refuges." Within a broader context, and given the fact that protection of the butterflies is in fact a direct result of conservation of the ecosystem, our goals are congruent with those of national and worldwide movements to protect ecosystems by setting up biosphere reserves.

For this reason, we submitted to representatives of agencies of the Secretary of Agriculture and Water Resources (SARH) and to the Governor of the State of Michoacan, Cuauhtemoc Cardenas, our preliminary proposal for the creation of a national park. The proposal was developed by Carlos Melo, M.S., of the Geography Institute at UNAM, who makes use of the national park concept to coordinate problems of demographic pressure, land tenure, forest exploitation, and tourism, with measures to facilitate scientific research and conservation.

The title of our proposal is: "A Preliminary Proposal to Create a National Park in the Chincua, Rancho Grande, and Campanario Mountain Ranges of the States of Mexico and Michoacan." It envisions a park area of 11,000 hectares roughly above the 3,000 meter line, to reflect the approximate altitude at which overwintering colonies form at different sites.

The proposal calls for three stages of development: preparatory, analytical, and synthetic.

In the first stage bibliographic, cartographic and aerophotographic data would be collected concerning the components of the cultural environment, such as soil, water, geology, temperature, precipitation, flora and fauna, as well as the human aspects of land tenure, land use, communications, public service projects, economic structure, and others.

Also in this stage, a basic map would be developed to illustrate the data compiled, such as landscape, contour lines, drainage system, and existing infrastructure and services such as electricity, water lines, highways, and settlements.

The second, or analytical stage, would consist of processing and interpreting the data selected in order to formulate a diagnosis of the natural resources found in the area suggested for the park, and to identify influences present in these surroundings. The geographic and political location of the area would be determined, as well as its regional influence on settlements, transportation systems, land use and economy, drainage flow dynamics, water quality and its implications for ecological balance in the area, the shape of the area in relief, research on geological conditions related to soil processes and to water runoff and seepage, and finally, different types and combinations of soil and their resistance to erosion.

A vegetation study, including an inventory of flora to learn the forest's structure and diversity, would take into account disturbances affecting the forest, such as fires, pests, and lumbering. With respect to animals, a census would be taken to relate them to their respective ecological niches and to determine various phenomena such as migratory, nesting, and overwintering habits, endangered species, and other facts such as predation and biological controls.

Weather phenomena, together with other components of the landscape, such as relief, altitude, and vegetation, will establish the features of the various climatic environments.

The third, or synthetic phase, will see the integration and interpretation of all the various factors considered in the previous stages in order to evaluate and classify the resources of specific areas. The types of area we have in mind, from the point of view of a national park, are those internationally

defined as:

The Untouchable Area. To conserve the natural environment. This area would be used exclusively for scientific activities, such as programs to study the Monarch butterfly's overwintering phenomenon, or other similar projects.

The Extensive Use Area. To preserve the natural environment while minimizing human impact upon the protected resource, and to facilitate public use by organized groups for educational purposes.

The Intensive Use Area. To facilitate development for environmental education and full recreational use, provided such activities are compatible with the natural landscape and have the slightest possible impact. This type of use would include tourism.

The Natural Restoration Area. To limit degradation of resources and permit restoration to the most natural state possible.

The Special Use Area. Composed of smaller areas to house administrative offices, personal and staff residences, warehouses, shops, and so on.

Because we are aware that a project of this scale requires time for its realization, and also in response to a suggestion made by the governor of Michoacan, we recently submitted a provisional proposal to reserve a minimal area at one of the overwintering sites, which would permit us to initiate continuous ecological research. This information would be useful for our studies, and would also support the work of other scientists, such as Dr. Lincoln P. Brower's group from the University of Florida.

The site we proposed was chosen after an exploratory visit that showed it to be little frequented, due to the difficulty of access. Vegetation is thus well preserved, and as far as the Monarch population goes, we found appreciably higher numbers of butterflies here than at other sites.

The site might be drawn to cover an area of approximately 19 km^2 around the peaks of Huacal and Chivati, in the municipality of Ocampo. The area would fall provisionally above the 2,800-meter line. The exact working site has not yet been adequately located on the map, but the following coordinates can be given as references: latitude 100°18′ north and longitude 19°31′48″ west. Activity in this area should begin with preliminary research on the area itself; simultaneously, the following steps we proposed to the governor of Michoacan should be taken:

1.) Suspension of all intervention in the forest over an area of at least 2 km^2 around the chosen site.

2.) Regulation of forest exploitation in the designated area.

Requirements

1 cabin, adequately heated, with the following rooms:

1 laboratory, 4 x 5 m
1 dining room, 5 x 6 m
1 kitchen, 2 x 3 m
2 bedrooms for research personnel, 3 x 5 m each
1 staff bedroom, 3 x 4 m

In addition, a fenced space about 10 x 4 m will be required for installation of meteorological equipment.

Additional Requirements for Field Work

Furniture
Four-wheel drive vehicle
Salaries for staff

For the time being, various aspects of the project are occupying our work group. Our team is made up of Dr. Leonila Vazquez G., Hector Perez R., M.S., Hector Gonzalez A., Biologist, Jose Carmen Soto, Passant in Biology, and Rosa Sanchez S., Academic Technician, all of UNAM's Biology Institute, and Carlos Melo, M.S., of UNAM's Geography Institute.

As a preliminary project in floral studies, botanist Jose Carmen Soto has proposed an investigation that he expects to complete in a year's time, given favorable conditions.

His project calls for studies of the overwintering sites and nearby expansion zones of the Monarch butterfly (*Danaus plexippus* L.) in the Chincua, Rancho Grande, and Campanario mountain ranges within the boundaries of the states of Mexico and Michoacan.

His general objectives are:

1.) To study the flora characteristic of the main Monarch overwintering sites located on the transvolcanic axis within the boundaries of the states of Michoacan and Mexico.

2.) To study the flora characteristic of areas bordering on the Monarch butterfly's overwintering sites, between the altitudes of 900 and 2,000 meters above sea level.

3.) To study distribution of the genus *Asclepias* L., and relate it to populations of *Danaus plexippus* found in a larval state in the aforementioned areas.

4.) To perform an ample and detailed phenotypic study of the genus *Asclepias*, including both its growth and reproductive stages, in areas close to overwintering sites.

5.) To formulate a vegetation map of the study area, with indications as to the present state of original vegetation.

The concept of a national park offers the necessary infrastructure for long-term research, and various government agencies would share in implementing the idea, particularly the SARH, for whom the aforementioned presidential decree reserves a governing role in butterfly protection. On the other hand, botanical knowledge defines the frame of reference for the ecological focus that represents the interests of UNAM's Biology Institute. These interests are derived from programs currently being carried out, from which a methodology is to be extrapolated to analyze the dynamics of the ecosystem. The method consists basically of interpreting the influence of the environment on the local fauna's different population variables. As part of this method, along with collection and systematic observation of zoological material, we are using measuring devices to compile data on the following environmental parameters: relative humidity and ambient temperature, solar radiation, evaporation, wind velocity, wind direction, atmospheric pressure, and rainfall.

A complete set of equipment would be installed at a strategically located meteorological station, while another set of equipment would be transported to various locations, according to the needs of different work projects. This system would allow for correlation at four different levels: the microclimatic level, with information provided by the mobile equipment; both daily and monthly meterological levels, with data from the main weather station; and the regional climatic level, with climatic norms for the entire area.

The research we are currently planning will revolve around the Monarch, whose population dynamics are the subject of particular attention by our various research teams, and we hope to apply the same analytical concepts to the butterflies' life cycle and migratory behavior.

Mariposa Monarca

Juan Jose Reyes Rodriquez

Fauna Silvestre, SARH, Mexico D.F.

Beginning in 1973, when the first overwintering colonies of the Monarch butterfly were found in the states of Mexico and Michoacan, a forest species previously ignored by most citizens, and known by a few locals only as "*las palomas*," took its place in the foreground of our national scene.

This species of the order Lepidoptera, particularly interesting for the colorful contrast of its hues, as well as its gregarious habits and the migratory drama it yearly plays out in a uniquely beautiful, temperate-zone forest setting, sparked the public's interest. The public first learned of the overwintering phenomenon through an article published in an internationally known journal, and publicity reached a peak in the documentary films and other journalistic and scientific articles that followed.

As a result of interest and participation by both national and foreign organizations, state governments, private enterprise, and the office of the Secretary of Agriculture and Water Resources (SARH), acting through the Subsecretary of Forestry and Wildlife, areas where the butterfly known as the Monarch overwinters and reproduces, including areas that shelter the species, were declared protected forest zones and wildlife refuges by presidential decree on March 25, 1980, in order to insure the preservation of the species' habitat.

This laid the foundation for a costly research program to discover the geographic locations of overwintering colonies in our country.

This research is of interest both to scientists, and increasingly to conservationists at an international level, due to the concern we all share for keeping these populations safe from threats to their survival.

The Monarch, due to its evolutionary characteristics, is intimately adapted to the natural areas that harbor its overwintering populations, and the importance of these areas expresses itself in their particular ecological features. For this reason, the butterflies' survival implies the need to preserve the biological mechanisms and natural cycles that define and regulate ecological interactions in these areas.

Let us not forget that the species' migratory populations must confront and analyze many adverse factors, among them a series of environmental disturbances and deficiencies affecting those regions, or biotic provinces, that offer them shelter and food during their migratory movements. Together these factors act to give Monarch populations a high degree of specific fragility.

No less important are the potential threats posed in overwintering areas by accidental or deliberate fires, poorly channeled tourist movement, disturbances due to noise, and cattle grazing, all activities that imply a significant threat to the integrity and biological future of the species.

At the present time, the Secretary of Agriculture and Water Resources, acting through the Wildlife Department, and in full awareness of the importance to our country of conserving forest species (a term used to include all land invertebrates, and hence the species in question), intends to do the following.

1.) Lay the groundwork for elevating the natural areas that sustain the species to the status of Specific Reserve Areas (refuges linked together to form a system). Preserve conditions essential to the safety of the species' population. Organize a system and consolidate measures designed to achieve conservation of the ecological mechanisms and characteristics that define the species' natural surroundings, and hence enable these surroundings to support butterfly populations.

2.) Extend this reserve-area model to other natural areas, not yet specified, whose protection and maintenance are of great importance as zones that form an essential part of the butterfly's migratory trajectory.

3.) Support the official initiative shown by the governor of Michoacan and worldwide conservationist organizations.

4.) Stimulate a flow of economic goods and labor power into the rural sector, using the managerial potential of a system of wildlife refuges to bring greater economic benefits to rural areas.

5.) Extend all possible facilities to specialists and scholars in this field in order to promote greater knowledge of the species, which will in turn contribute to our adopting the most appropriate measures for its management.

6.) Promote and publicize the importance of the species, giving consideration to needs for conservation, research, education, recreation, tourism, and other uses.

Reserve areas and wildlife refuges are defined as any area designated by the Chief Executive for conservation and use of natural resources under government supervision. Within these areas, the existing flora and fauna will be offered every possible protection compatible with the purposes for which such areas are created. Such areas have the dual purpose of protecting nature and educating or providing recreation for the public.

Consideration will be given to multiple, or compatible, uses of the landscape, and immediate actions for protection of characteristics essential to survival of the species will be provided for.

The Secretary of Agriculture and Water Resources has been charged with insuring exact observance of and compliance with the provisions of the relevant legislation, and consequently with taking such steps as may be necessary to protect and supervise propagation of any wildlife deemed eligible for management.

Through its subsidiary, the Wildlife Department, the office of the Secretary of Agriculture and Water Resources has also been developing a series of conservation-related activities in areas that serve as overwintering grounds for Monarch populations in the states of Mexico and Michoacan. We can sum these up as follows.

a.) We are developing a regulations prospectus for reserve areas, wildlife refuges, and biosphere resurves to consist of an initial chapter on administration, subsequent chapters on local residents, visitors, land tenure, land use and human settlements, conservation, development, promotion and exploitation, trade and permits, research, education and publicity, and a final chapter on general provisions.

This project is currently under final review by the various department heads concerned.

b.) Internal meetings have been held in the various departments subordinate to the Subsecretary of Forestry and Wildlife, to coordinate their respective activities and normalize criteria with regard to conservation of the natural areas in question. The participants in these meetings have been the Departments of Forest Control and Supervision, Reforestation, and Forest Exploitation, as well as the Institute for Forestry Research, the Technical Assistance Unit (Public Education), and the Chiefs of Forestry and Wildlife Programs for the states of Mexico and Michoacan.

c.) Plans have been made to set up a joint committee with representatives of interested scientific institutions.

d.) We have been cooperating actively with the government of the State of Michoacan. Recently, technical personnel from the Wildlife Department were commissioned to participate in surveying the overwintering areas thus far discovered with an eye to land tenure problems, a joint project with personnel from the Mixed Agrarian Commission of the state of Michoacan. Seven natural areas now occupied by Monarchs in three different municipalities of the state were surveyed. Allowance was made for a surface area large enough to reflect the behavioral characteristics of the species. The survey included within the protected area not only the space occupied by the colony in its overwintering phase, but also a more extended area to serve as a buffer zone for further protection.

e.) We cooperated with North American scholars in studies performed during March of 1981 to determine the location of Monarch butterfly colonies in the state of Michoacan.

f.) Since 1978 we have had a specially commissioned staff to carry out supervisory duties at the butterfly colonies, and we have plans to enlarge the crew.

g.) Our office has specifically commissioned permanent technical personnel to the state of Michoacan to develop future activities.

h.) Part of a public education program has already been carried out in the municipality of Ocampo, covering the following *ejidos* (communal villages): San Cristobal, Laguna Verde, Asoleadero, Ocampo, Santa Ana, and Trojes. We have used this program to educate *ejido* members as to the importance of the Monarch butterfly.

i.) We have also held meetings with the municipal presidents and *ejido* delegates of Angangueo, Tlalpujahua, Contepec, and Ocampo for the same purpose.

j.) We have determined natural conditions present in the various overwintering areas used by Monarchs and associated wildlife.

k.) Personnel from this agency have participated in the work performed by scientists from the University of Florida.

l.) A project exists to continue and increase programs of public education at a regional level with Monarchs as their sole subject.

m.) We have cooperated with the Biology Institute of the National Autonomous University of Mexico, with the Televisa television network, and the private Monarca Society.

n.) We have also cooperated with the World Wildlife Fund-U.S., with Amherst College, Scarborough College of the University of Toronto, the University of Florida, and the Species Survival Commission of the International Union for Conservation of Nature and Natural Resources.

o.) We are currently developing a management project for a system of Monarch butterfly refuges.

Finally, in the name of the Department of Wildlife Management we would like to extend our visitors a cordial welcome to Mexico, in the hope that this conference will have the desired effect. We are happy to offer you our support and cooperation.

Development of the Civic Group, Pro Monarca, A.C., for the Protection of the Monarch Butterfly Wintering Grounds in the Republic of Mexico

Rodolfo Ogarrio

Pro Monarca, A.C., Mexico City, Mexico

In January of 1977, as a result of publicity the *National Geographic* gave to sites where the Monarch butterfly overwinters in the Mexican republic, and thanks to a series of fortunate circumstances, we had a chance to visit one of the largest Monarch butterfly colonies.

The impact this unique phenomenon had on the people present at that visit moved us to find ways to insure that places like this, selected down through the centuries by millions of living beings as their place of repose for the winter months of each year, would be respected and cared for by humans. We are the only beings capable of preserving a species, but we are also the only ones capable of destroying it.

When we began our activities, the site was practically unknown. Along with certain difficulties we encountered at the beginning, we received a recommendation from conservationists more experienced than ourselves not to do anything—to hope that the site would not be discovered by anyone else, in the faith that its best protection lay in continued anonymity.

Because of the desire of urban residents for the experience that nature offers, and the nearness of the site to one of the planet's most heavily populated areas, more and more people learned of the location by word of mouth. They came to visit,

thus endangering by their mere presence the delicate balance so indispensable for survival of the Monarch butterfly. In March of 1980, we concluded that it was utopian to imagine that the site would remain unknown and unvisited, hence undamaged, so we decided to work to help preserve the species in any way possible.

We established contact with the Biology Institute of the National Autonomous University of Mexico (UNAM), with the Wildlife Department under the Subsecretary of Forestry and Wildlife, with the Secretary of Human Settlements and Public Works, and with the Mexican Society of Lepidopterists, all of whom were already working to achieve the same conservation goals.

We realized that the danger threatening the Monarch butterfly was of interest and concern not only to a significant number of officials and scientists, but to other persons as well.

In view of the situation, we formed a private association, known as "Pro Mariposa Monarca." The only motive for its creation was to assist in achieving protection of sites where the Monarch butterfly overwinters within the territorial boundaries of the Mexican republic. Its private, non-profit status enables the society to bring together members of various institutions that share a common interest, independently of whether they belong to the government, scientific, or private sector, and whether they be Mexicans or foreigners. One of the purposes of Monarca has been to offer an appropriate medium through which anyone interested in doing so can cooperate in achieving the society's aims.

Given the irreversible reality created by discovery of the Monarch's overwintering sites, we saw fit to commission a study that would allow us to diagnose the principal problems threatening the butterfly, and to propose solutions to those problems.

To this effect "Aleph, Inc., Associated Consultants," a company made up of specialists in ecological studies with ample previous experience in studies prepared for the Secretary of Agriculture and Water Resources, presented a plan whose general objectives were as follows:

—To conserve ecological processes and vital systems in order to achieve a form of development that can be sustained in the long run.

—To conserve genetic diversity.

—To insure survival of species and ecosystems in the area around Angangueo, Michoacan.

—To insure the continued existence of the esthetic and biological aspects of the Monarch butterfly for scientific purposes.

—To implement immediate protective operations in Angangueo to serve as a concrete experience and as a first step in this country toward establishing a master protection plan for *Danaus plexippus* at a national level.

Among its more specific objectives, the aforementioned plan calls for a description of the Monarch butterfly's ecological setting in order to facilitate the following:

—Identification of the impact that natural and human threats

may have on the species and its ecosystem.

—Formulation of an emergency plan for protection of the butterfly and its environment in order to insure the Monarch's survival in the Angangueo, Michoacan area.

—Provision of technical support and suggestion of concrete actions that would allow government authorities to offer effective protection of the Monarch butterfly and its natural overwintering habitat in the short run.

—Formulation of an education and information program for the local public, as well as for outside visitors and officials, to facilitate implementation of the plan.

The theoretical framework proposed would encompass a description of the species' characteristics, of the natural ecosystem, and of the general ecology, flora, fauna, hydrology, climate, geology and orography of the region, as well as the impact of natural influences (erosion, natural fires, etc.) and human works (settlements, infrastructure, services, transportation, productive activities, recreation, tourism, hunting, fires set by human hand) on the environment.

The plan calls for quantification of environmental impacts and diagnosis of the current state of the environment. It seeks to discover correlations between effects on the environment in general and specifically on *Danaus plexippus*, such as programs for public works and services. It also includes a strategy for action, the outline of a management plan, and a statement of the investments, maintenance, and apportionments of responsibility necessary to implement this emergency plan.

An orientation map to aid in implementing the emergency plan was drawn at a scale of 1:5000, in which specific proposals were presented in graphic form.

Monarca's desire to cooperate has been well received by the authorities, and based on the presidential decree of April, 1980, we have submitted to appropriate officials a proposal to carry out simple, but vital actions. These actions, founded on the study prepared for us, will permit the Monarch butterfly's overwintering sites to be duly cared for. We would consider lamentable any development in an area so fragile that the mere presence of large groups is sufficient to endanger its integrity.

We nevertheless recognize the inevitable fact that in years to come, more and more people will have an impact on these sites.

Monarca's members will continue to work to insure that those who interact with this unique phenomenon will do so respectfully, committing themselves in the process to guarantee conservation of the species.

Magnetism as a Complementary Factor to Explain Orientation Systems used by Monarch Butterflies to Locate their Overwintering Areas

Fernando Ortíz Monasterio
Vicente Sánchez
Hugo Gonzalez Liquidano
Marta Venegas

Pro Monarca, A.C., Mexico D.F.

"There are other worlds,
but they are in this one."
—Paul Elouard

Introduction

The excitement we felt upon seeing millions of Monarch butterflies at their overwintering sites gave rise to the obvious thought that here was a biological event characterized by intense "vibrations."

As simply as that did we begin our study of vibrations and magnetism in connection with the Monarch butterfly.

Out of a spirit of serendipity and challenge to human thought, the following working hypothesis emerged—"The Monarch butterfly's orientation system for locating overwintering areas may be explained by, among other factors, electromagnetism that attracts them to areas of high magnetic intensity."

We don't presume to have here a fully substantiated hypothesis, but we do believe that a series of ideas structured in a reasonably connected manner can contribute to clarifying the real complexity and wonder of *Danaus plexippus*'s migratory behavior.

The working goal of our group, it is worth noting, is not to advance the frontiers of knowledge concerning the Monarch, but rather to further protection of the species.

Our specific task was to propose a master plan for protection of the species and its overwintering areas (Aleph, 1980). Quite incidentally, in the course of person to person discussions, fraternal conversations and mountain chats, we came to experience more and more curiosity about the as yet unsatisfactorily resolved questions we are raising here.

Basically, we found two lines of inquiry for which science apparently has not provided a definitive set of answers.

1.) How is it possible for a species of Lepidoptera whose anatomy consists primarily of a means of locomotion to have a sensory system sufficiently sophisticated to select, from among a multitude of ecosystems it encounters along the route between Canada and Mexico, the very one where it is to spend the winter?

2.) How is it possible for genes to transmit not only the annual migratory rhythm, but also the precise location where the Monarch is to overwinter, without the individual organism having ever been there?

We believe that, in addition to food, water, appropriate substrates to cluster on, and other indispensable environmental conditions, such as an appropriate climate and altitude, aquaterrestrial magnetism may be a complementary factor helping to explain this fascinating migratory process. Within our limited perspective, we will try to demonstrate how this is so.

The Magnetic Field

The earliest magnetic phenomena observed in the course of humanity's scientific and technological development were natural magnets, or pieces of a particular iron ore found near the ancient city of Magnesia. Natural magnets have the property of attracting unmagnetized iron, especially in the so-called polar regions.

The Chinese knew, prior to the year 121 of the current era, that a bar of iron placed near a magnet would acquire and retain this property of natural magnets, and that if the bar was then freely suspended so that it could revolve around its vertical axis, the bar would orient itself in a north-south direction.

The use of magnets to facilitate navigation may be traced back at least to the eleventh century. For many years our knowledge on the subject of magnetism was limited to these simple conclusions. It was not until 1819 that Danish physicist Hans Christian Oersted demonstrated the correlation between magnetic fields and the flow of electricity, thus opening up a whole new field for investigation.

Presently, we know that so-called magnetic phenomena originate in forces created between electrical charges in motion. That is, moving electrical charges exert magnetic forces on one another, in addition to the purely electrical or electrostatic forces described by Coulomb's Law.

Given the fact that electrons are in motion around the nucleus of an atom, and that each electron appears to be constantly orbiting around an axis that passes through the atom, it is to be expected that each atom will exhibit magnetic properties, and in fact modern physics has proved this to be the case.

Just as atoms maintain a dynamic equilibrium, it has been found that the planets behave similarly in their orbits around the sun. There are also magnetic fields associated with moving clouds of interstellar gas.

It is thus highly important to underline the electromagnetic principle that like charges repel one another, while unlike

charges attract. This very principle constitutes one reason (if our hypothesis is correct) why Monarch butterflies overwinter where they do.

The general idea of magnetic attraction would indicate that geomagnetic fields cannot help but attract Monarchs. Once they are in the right general area, the butterflies seek the remaining physical and biological elements necessary to their winter survival.

The Earth as Magnet

The Earth's magnetism has been a topic of discussion since 1600, when William Gilbert first demonstrated certain of the planet's magnetic properties. He theorized that the Earth's magnetic field resulted from the presence of a large, permanently magnetized body at the center of the Earth.

Currently we know that over time, the Earth's magnetic fields vary not only in intensity, but also in their rate of change. Aircraft and marine pilots are aware of this, since they must continually update their geomagnetic maps.

Interestingly, in spite of great changes in the Earth's magnetic fields, there are certain places on the planet whose magnetic field lines have remained remarkably constant in intensity and direction.

Also significantly, the most magnetically stable areas are those associated with volcanic activity, such as the transvolcanic axis in the Americas, or in the area around the volcanic islands of the South Pacific Ocean.

Magnetic charts of the Earth from 1912 and 1942, show that Mexico is one of these relatively stable magnetic areas, both with respect to intensity and direction of field.

The Transvolcanic Axis

The Monarch butterfly's overwintering areas in Mexico are composed of igneous andesite, basalt, and volcanic andesite fault formations. That is to say, a direct correlation exists between the transvolcanic region and *Danaus plexippus*'s overwintering areas.

The transvolcanic axis, which runs roughly east to west at an approximate latitude of 19° north, occasioned a brutal break in the shape of the American continent. The Sierras Madre Oriental and Occidental, which took shape hundreds of millions of years ago, were laterally separated only some 12 million years ago, thus giving rise to Cuba, the Antilles, and all our Mexican volcanoes and geothermal zones.

At this point we should keep in mind that, just as geomagnetic fields originate in the magma lying at the center of the Earth, so the presence of recent volcanic activity on the surface (as in the case of the Paricutin Volcano that erupted in 1943) or the existence of permanently active geothermal areas is also associated with surface magnetic fields distinct from those occurring elsewhere on the planet.

How interesting that the Monarch's overwintering areas, both in Mexico and the United States, are located in highly active volcanic and geothermal zones. Is it not likely that this indicates a relationship?

The Angangueo, Michoacan Area

The area around Angangueo, for which the Master Plan for Protection of the Monarch Butterfly and its Overwintering Area was developed, corresponds to the oldest continually operated human mining settlement in Mexico. It is known that the Tarascans extracted ore for at least 700 years during the prehispanic period. During the colonial period, the area remained continuously in production. The American Smelting Company earned copious profits here at the beginning of the present century, and more recently the Impulsora Minera of Angangueo has continued to operate what is the area's principal mine.

It was a great surprise to us to find that the overwintering areas form a virtual circle around the mine, which, due to the presence of iron sulfide, or pyrite, as well as arsenic sulfide, or arsenopyrite, gives magnetic readings 90 to 100 times higher than those of surrounding areas, according to local mine geologists.

Much greater was our suprise, nevertheless, when we learned that recent research on the wing structures of *Danaus plexippus* found them to contain small quantities of magnetite.

Not only does the documented presence of an adequate ecosystem in the area around Angangueo explain why, year after year, millions upon millions of butterflies fly into the area with such marvelous precision; but also,once the butterflies have launched themselves on the adventure of their southward journey, they may be attracted to their overwintering sites as an airplane is guided in by an airport's radar system.

The butterflies, subject to an ineluctable law of physics, cannot help but be drawn to areas of high magnetic intensity.

In our hypothesis, we lay emphasis on the complex response of living beings to a large number of phenomena, many as yet unknown, which combine to permit the pattern of animal life.

We do not believe that the importance or capability of the species is in any way diminished by supposing that it "finds" the overwintering area by some means other than its senses. On the contrary, in a certain sense it is the area that "finds" the butterflies, and the dialectical relationship this implies between the organism and its environment is what gives the migratory phenomenon of the Monarch butterfly its true majesty.

Magnetism and Animals

Beginning in 1780, when Luigi Galvani, a professor of anatomy at the University of Bologna, performed his earliest work with the response of animals to electrical phenomena, a substantial number of experiments has been carried out on the effect of electromagnetic fields on the nervous system of various species. The field today is far from being fully explored.

Recent work has focused on magnetism and the directional orientation of various species. Undoubtedly the most advanced work is that of Charles Walcott and his associates at the State University of New York, Cornell, who attached a Helmholtz coil and a battery, which they used to generate small magnetic fields, to pigeons. They found that at night, that is in the absence of the sun as an alternative orienting device for the pigeons, the birds became completely disoriented when subjected to magnetic fields. This suggests that magnetic information has something to do with the way pigeons navigate.

Their findings are consistent with those of Friedrich Merkel and Wolfgang Wiltschko, of the University of Frankfurt, who concluded that European nightingales may use magnetic codes to orient themselves in a particular direction.

If the foregoing reflections permit any conclusion, it is that geomagnetic fields may exert a determining effect on Monarch butterflies as they do on other animals. *Danaus plexippus* may

navigate such fields like a vessel traversing invisible energy streams in its search for the overwintering area.

In conclusion, we offer a final thought worth reflecting upon. The first center for scientific research in the Americas opened its doors to students of the exact sciences in 1428, under the wise academic leadership of Netzahualcoyotl (1402-1472), who built the Palace of Quetzalpapalotla and dedicated it to the divine butterflies who bore the souls of dead warriors to other, mythical worlds. Recent studies carried out by NASA when the magnetic-field satellite *Magsat* returned to Earth after 8 months in space, with its immense store of information, have provided new data that conclusively demonstrate the complex interaction between biological phenomena and magnetic fields.

Mexican scientists of the fifteenth century would have been surprised beyond words by the technological complexity we would later attain. It should be an equal surprise to us, in the twentieth century, to find that we are asking ourselves the same basic questions as our ancestors.

Conclusions

Based on the foregoing information, we can formulate the following conclusions with some degree of confidence.

There exists a series of physical and biological phenomena, among them *Danaus plexippus*'s means of finding its overwintering grounds, that modern science has not adequately explained.

In the case of the Monarch's overwintering areas, we have a series of "coincidences" which may be more than just that. Outstanding among these coincidences are the following facts: that butterflies have magnetite in their wings, that Angangueo is a center of strong magnetic fields, that the overwintering sites are radially distributed around the center of Angangueo's mine, and that the Monarch always overwinters in volcanic and geothermal areas.

It has been demonstrated that pigeons and nightingales use magnetism as one of their directional aids.

We can conclude, finally, that experiments to measure geomagnetism in relation to the Monarch butterfly should be undertaken, in an effort to quantify the magnetic field hypothesis and explain how this species locates its overwintering sites.

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The Status of Monarch Butterfly Overwintering Sites in Alta California

John Lane

3174 Scriver Street, Santa Cruz, California 95062, U.S.A.

I would like to thank the organizer of this symposium, Robert Michael Pyle, for inviting me to present this paper to you today. I am honored to be a part of this significant occasion. This symposium is a cause for optimism for the future of this butterfly. But this symposium is not without irony.

I say irony because even though overwintering Monarch butterflies have been known in California for nearly 100 years, there has never been such a meeting before. This conference in Mexico is being held just over five years after the momentous discovery of the Mexican overwintering sites. Indeed, it seems that the interest aroused by the recent Mexican discovery has been the spark to at last kindle serious interest in California's long-known yet little-studied overwintering Monarch butterflies.

Common Myths

I am often surprised that so many people in California know at least something about Monarchs, such as that they migrate, or that they cluster in trees somewhere. But far more surprising still is how widespread two common myths are about overwintering Monarchs in California: first, that they only come to certain trees in Pacific Grove, and second, that they are thoroughly protected there.

Pacific Grove is unique among the many seacoast towns which have overwintering sites; long ago this town cast its lot in with that of the butterflies. Monarch butterflies appear widely as logos—on city signs, businesses, post boxes, and so on, and it has been called "Butterfly Town, U.S.A." Each fall, the town's schoolchildren, costumed as Monarchs, participate in a parade to welcome the returning migrants, and tourists flood the area to see the parade, the butterflies, and also to enjoy the mild climate and superb beauty of the Monterey Peninsula region.

The town has for many years had an ordinance protecting the butterflies from molestation with a $500.00 fine. As a result of this, the general public in the state associates Monarch butterfly overwintering almost exclusively with this one small resort community. Indeed, it is sometimes difficult to begin to discuss the status of overwintering Monarchs in the state with decision-makers because of this tenaciously held belief that Monarchs overwinter only at Pacific Grove, where they are thought to be so stringently protected. As we shall see, both assumptions are false.

Original Discovery

Despite the fame the butterflies at Pacific Grove enjoy today, there is almost nothing known about their original discovery. Monterey was the capital of first Spanish and then Mexican Alta California, and an important sea port on the central California coast. Many naturalists visited the area and had time to explore the region while waiting (sometimes many months) for their ships to arrive. The peninsula, a few miles west of Monterey between Pacific Grove and Carmel, is biologically strikingly unique and attracted many of these naturalists. But I know of no reports from this period telling of the overwintering butterflies.

Monterey and the surrounding areas remained a quiet, sleepy district through the early American period until the early 1800s when the Southern Pacific Railroad arrived, and with it the tourist industry. Pacific Grove was founded as a religious retreat in the early 1890s, and became a popular resort community. From its earliest days, a pastime of its visitors was to ride out to the lighthouse (which marked the southern end of the Monterey Bay) and on the way, during the winter months, stop and see the famous "Butterfly Trees". One of its early residents, Lucia Shepardson, wrote the first significant account of the overwintering butterflies in the small booklet, *The Butterfly Trees* (Shepardson, 1914). This excellent, but rare, work was based on her own observations over many years, but of the original discovery, she has little information to offer, as she mentions only that a few locals had first noticed the butterflies in the 1860s, and that they had not been noticed earlier. Thus the details of the original discovery of the Monterey Peninsula overwintering sites remain obscure.

As will be discussed later, many of the overwintering sites found in the state today were not in existence in "pristine" (pre-contact) California before the arrival of Europeans. The limited number of overwintering sites in pre-contact times, and the historical pattern of settlement in the state, suggest that the discovery of any other overwintering site would have come well after the original discovery on the Monterey Peninsula. On the whole, the literature neglects to mention the first discovery of any of the state's Monarch butterfly overwintering sites.

Present Distribution

Monarchs are known to cluster today at numerous localities along nearly 500 miles (about 800 kilometers) of California's coastline, from north of San Francisco south to the Mexican border (Fig. 1). No cluster sites are reported in Baja California. Alta California cluster sites are all situated at low elevations close to salt water. They occur in topographically protected locations (as on the lee side of a hill or in a protected canyon) and/or in the shelter afforded by the tree canopy of the surrounding forest. Major sites all have reliable sources of fresh

Fig. 1. Representative locations of Monarch Butterfly overwintering sites in California. Not all sites are shown, but the distribution range of overwintering is indicated. Colony sites shown by black dots, except three indicating presumed pristine (pre-contact) overwintering sites shown by black circles.

water.

There has never been a thorough survey of overwintering sites in California. The only published lists of overwintering sites are 20 to 40 years old and are clearly incomplete; many of the colony records are anecdotal, based on single observations by untrained observers (Downes in Williams *et. al.*, 1942 and accounts scattered throughout Urquhart, 1960). Furthermore, all these listings confuse temporary "bivouacs" with permanent overwintering sites. Often, during the fall migration, "bivouacs" will form for a night or two or even a few weeks before the butterflies disperse and move on to permanent colonies which are utilized all winter long, every winter. To reiterate, there has never been a comprehensive survey of the state's overwintering colonies, and published lists are incomplete, largely anecdotal, and fail to distinguish between trivial, temporary clusterings and major, permanent cluster sites.

There has been little rigorous scientific study of overwintering Monarchs in California to date. Hill *et. al.* (1976) first reported the unusual aggressive mating behavior of overwintering Monarchs at the cluster sites. Tuskes and Brower (1978) monitored three overwintering colonies through one overwintering period for total numbers of butterflies in residence, sex ratios, percent of females mated, wing condition and lipid content through the overwintering period. The best studied colony is probably Natural Bridges Beach State Park in Santa Cruz (one of Tuskes' study sites). The famous Pacific Grove sites have never been scientifically investigated.

Historical Trends and Conservation Status

With perhaps over 40 large, significant overwintering sites in existence in California today, it might be fair to ask whether protection and conservation is needed at all. In this regard, it is important to note that the great majority of these overwintering sites occur on private property, and as such have very little or no protection at all. If the owners choose to develop the land in some way, they are largely free to do so. They would need to meet local building codes, zoning ordinances, and the like, but the fact that an inspiring biological phenomenon would be upset would not in itself deny them the right to develop their land. Of course, for any consideration to be given the cluster sites, local planning agencies must be aware of those sites (and they rarely are in my experience). Fortunately, a few large overwintering sites occur on public lands, but even their futures are not assured.

Before discussing the future status of Monarch overwintering sites on public lands, and related problems, it is of interest to discuss two historical trends. These have influenced the occurrence of overwintering sites in California, and they continue to have an important bearing on the conservation of such sites.

Introduced *Eucalyptus* and Native Roost Trees

The great majority of overwintering sites in California today occur in groves of introduced *Eucalyptus* trees and thus could not have existed in the same form in pre-contact California. These *Eucalyptus* sites have all resulted from the introduction of the Australian trees in the last century; like the Monarch, *Eucalyptus* has found a home in California near the ocean where it rarely freezes.

Two native species of trees constitute the roost trees of virtually all non-*Eucalyptus* overwintering sites. Both of these, Monterey Pine (*Pinus radiata*) and Monterey Cypress (*Cupressus macrocarpa*), occur widely today because they have been planted horticulturally and as windbreaks throughout coastal California. In earlier times they both had highly restricted distributions (Griffin and Critchfield, 1972). Monterey Cypress was entirely limited to the Monterey Peninsula and Point Lobos a few miles to the south. Monterey Pine in pre-contact California occurred in those same areas, as well as near Cambria Pines (by Morro Bay) and near Año Nuevo Point (between Santa Cruz and San Francisco).

Thus, in pre-European-contact California, there apparently could have only been three limited, widely separated areas where overwintering Monarch colonies could have occurred—those areas where either Monterey Pine or Monterey Cypress ocurred in native stands (see Fig. 1). And, with the introduction and spread of *Eucalyptus*, the number of Monarch overwintering sites in California has increased.

An interesting corollary to this trend suggests that in pristine California those few overwintering sites had in residence greater numbers than are seen at any single site in the state today. The largest colony estimate at this time comes from Tuskes' (1978) study at Natural Bridges where he estimated nearly 100,000 butterflies in residence. But this number pales in comparison with the estimates of over 10 million butterflies at some Mexican sites (Brower, *et. al.*, 1977). Perhaps California's colonies were much larger before their adaptation to *Eucalyptus* dispersed their numbers.

Deteriorating Quality

Along with the increased numbers of overwintering sites due to the introduction and spread of *Eucalyptus* in recent times, there has been a second widespread historical trend throughout the state—the loss of overwintering sites, or their environmental degradation. Development threatens many overwintering sites in areas where local planners do not know of the sites, or choose not to protect them. Pacific Grove, where the butterflies are best known and highly valued economically, furnishes a dramatic example. In the booklet *The Butterfly Trees* Lucia Shepardson (1914) made clear that several cluster sites around Pacific Grove were lost early in this century due to development or accident. When these sites were lost, she noted that the butterflies did not take up new quarters nearby, even though to human eyes, there seemed to be lots of suitable-appearing habitat available. This suggested to her that we should be protective of the areas the butterflies choose for their own reasons. But this lesson remains to be taken to heart. In Pacific Grove, the ordinance protecting the butterflies *just* protects the butterflies themselves, and not their overwintering habitat. Thus, in spite of individual butterflies being protected upon penalty of a $500.00 fine, development in recent years has caused the decline or outright demise of some of the few remaining overwintering sites even in this most famous area.

One motel, with the now unfortunate name of The Butterfly Trees Lodge, has lost all its overwintering clusters. Additional development within the pine forest (units have trunks and branches of the trees growing inches away from windows, walls and patios) changed the area enough so that the butterflies have not returned. The other motel with butterfly trees, Milar's Butterfly Grove Motel, may have exhibited declining numbers of butterflies in residence recently due to the development of a large apartment complex next to the motel. New plans call for development of the remaining small area of open forest around the butterfly trees with additional housing.

Only one other overwintering site remains in Pacific Grove. it is located in a city park, unmarked, and safe from development at this time. Clearly, it is not enough to simply protect the butterflies; protection must be extended to the entire roosting habitat, including both the cluster trees themselves and the surrounding forest as a buffer.

If the situation at famous Monarch sites involves killing the goose that laid the golden egg, consider the problem where the Monarchs are anonymous. Coastal land prices in California are such that a colony without a built-in clientele would stand little chance of survival in a pitched development battle. This is yet another reason why a thorough survey of all sites should be conducted as soon as possible.

California has a handful of overwintering sites on public lands, most of them in state parks. But even here, park managers and planners are often unaware of this special resource; or have not considered the welfare of the overwintering butterflies in their long-range park plans. There is a long-range goal to remove the non-native trees from all California parks. If and when *Eucalyptus* groves are removed from these parks, many Monarch butterfly overwintering sites on public lands will be lost.

Where park planners do know of their overwintering Monarchs, they sometimes evince an attitude that keeping the public away is the best policy. (It also makes for cheaper park operation.) There is only one state park, Natural Bridges Beach State Park near Santa Cruz, where active interpretation of Monarchs takes place. Signed trails lead to an observation area, and presentations about the butterflies by park ranger-naturalists occasionally take place. One park near Morro Bay has an unmarked trail leading to a cluster site, and periodically a leaflet about Monarchs is available at the site. One other park in the same area has a cluster site within a campground and, if asked, the rangers at the entrance will indicate the cluster site location to curious visitors. Most surprising of all, a recently published "coffee table" photo book featuring California's state parks (Engbeck, 1980) fails to picture or even mention overwintering Monarchs! One state park near Santa Cruz continued to trim branches from roost trees even after I informed the local district manager about the resident Monarchs. There is clearly a need to educate state park planners of the presence and significance of overwintering Monarchs in their parks, and to impress upon them the need for a long-term plan for the protection and management of their overwintering butterflies and their chosen habitats.

[Editor's Note: Since this paper was written, California State Park officials have responded to IUCN inquiries on the subject with a clear declaration of intent to protect Monarch sites wherever they occur on park lands. In addition, the California State Natural Areas Data Base has designated the Monarch an element for which data will be gathered, and opened an element computer file accordingly.]

The Future

Where does this leave us? What can we say about the current and future status of overwintering Monarch butterflies and their overwintering habitats in Alta California? I believe that depends on what we do in the very near future.

If we fail to reach state and local planners and decision-makers, the future bodes for continued neglect leading to eventual degradation of the resource and, ultimately, the loss of more and more colonies.

But if we work to improve the present situation by making planners and decision-makers aware of the significance and value of the resource, and the need for responsible management and protection, then the future for overwintering Monarch butterflies can be promising and bright. And, in that event, we can look back on this Symposium as an historic beginning and an unqualified success.

Finally, in closing, and looking to the future, I would like to suggest, based on my own personal observations, three additional areas for future efforts.

First, surveys of overwintering sites, wherever they occur, will aid in evaluating the resource to be conserved. It may well be that not all overwintering sites can be saved. In that event, it is important that we prioritize our conservation efforts and work for maximum protection for the most significant and biologically important overwintering sites. Any surveys aimed at determining the location, size, and quality of overwintering sites will be useful for future planning and conservation efforts. With special reference to Alta California, those overwintering sites which were existing in pristine times deserve our greatest conservation efforts.

Second, where overwintering sites are subjected to environmental changes and stress, we should monitor the colonies to attempt to learn about the tolerance of the butterflies to such change. Planning decisions on the local level often involve trying to determine "critical limits"—the question invariably arises, "How much development can we get away with before

we will negatively affect the overwintering butterflies and/or their habitat?" On a practical level, not knowing where such "critical limits" are leads (naturally) to a conservative "save everything—don't allow any development at all" attitude. While perfectly justifiable from the standpoint of protecting a resource, this may make the political reality of protecting anything at all more difficult. By not knowing where to draw the line limiting development, conservationists are made to appear unwilling to compromise. Thus, I feel that any monitoring of overwintering sites in the face of development or environmental change will be useful to conservation efforts. In one recent instance, plans were advanced to build a factory across the street from the Natural Bridges Beach State Park colony. Permission to build the plant was forthcoming, but developers were required to fund a seven year-long biological monitoring of the overwintering colony. At least, with this base of information, future planners will have some data on which to base their decisions when they have to decide between development and overwintering Monarch butterflies.

Finally, I feel that the most important step to take in order to protect and manage Monarch overwintering sites for the future is to allow the public to visit overwintering sites and have the marvelous phenomenon of migration and overwintering interpreted for them. Nothing else will win for the butterflies stauncher allies or more caring stewards than an informed, genuinely appreciative public. The butterflies, I feel, speak most eloquently for themselves. We have only to let people see Monarchs in their enchanted winter homes and know of their extraordinary migration to these select spots, for this biological treasure to be recognized as such and guarded for the future.

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International Efforts for Monarch Conservation, and Conclusion

Robert Michael Pyle

Conservation Monitoring Centre, 219c Huntingdon Road, Cambridge, England[1]

INTRODUCTION

Monarch butterflies, in their overwintering, migratory phase, present the greatest insect spectacle on earth. As the previous papers have shown, this phenomenon has been widely appreciated but its future is not to be taken for granted. The purpose of this symposium has been to explore the nature of Monarchs and their conservation needs. This brief concluding paper intends to place the issue in its international context and to suggest cooperative, cross-border directions.

HISTORY OF INTERNATIONAL INVOLVEMENT

In 1976, the Lepidoptera Specialist Group of the Species Survival Commission, International Union for Conservation of Nature and Natural Resources first convened, in Washington, D.C. At that time, conservation of the Mexican overwintering grounds of migratory Monarchs was unanimously designated the group's number one priority in world Lepidoptera conservation. Only a few months prior to that time, through the efforts of Professor Urquhart and his associates, had the phenomenon been brought to the world's attention. LSG members felt that its significance warranted such a high priority placement, and that international attention should be focused on safeguarding the Monarchs as soon as possible. Later, the Group reaffirmed this decision but broadened it to include the overwintering California Monarchs as well. Successive editions of SSC's Action programme included the IUCN mandate for urgent attention to this world resource.

In 1979, when the Species Survival Commission met in San Jose, Costa Rica, a resolution was passed asking the Chairman, Sir Peter Scott, to write President Lopez Portillo on behalf of Monarch conservation. This was done, and shortly thereafter the Presidential Decree referred to in previous papers was issued. North American bodies including the National Geographic Society, the Secretariat of the Smithsonian Institution (at the urging of Ricardo Bartholemy) and World Wildlife Fund-US went on record supporting Monarch conservation efforts. These groups and others began to work with Monarca, A.C. when it came on the scene in Mexico. WWF-US began providing financial support for critical management research investigations. The Xerces Society, the international invertebrate conservation organization, concurred in LSG's view of the importance of this matter. Other insect conservation groups around the world, including the Joint Committee for the Conservation of British Insects, the British Butterfly Conservation Society, the Conservation Committee of the Society of European Lepidopterists and others recorded resolutions in support of Mexican and Californian actions toward Monarch protection.

Major media attention to the spectacle was inevitable, ever since the first *National Geographic* article broadcast its existence to the world. Mexican Televisa worked with Professor F. A. Urquhart, Dr. L. P. Brower aided American TV networks and Robin Crane produced a BBC film on Monarchs. Each of these productions received extensive international showings. This greatly enhanced world awareness of the Monarchs' existence, appreciation for them as a planetary resource, and concern for their protection.

INTERNATIONAL STRATEGIES

Beginning in 1980, a series of international delegations visited Mexico in order to discuss the long-range future of the Monarch with Mexican officials and scientists. These parties generally included representatives of World Wildlife Fund, IUCN, the Xerces Society, the press, and research institutions involved with the insects, notably the University of Florida. Professor Lincoln P. Brower of that institution (and President Elect of the Lepidopterists' Society) headed these working parties, while Dr. Thomas Lovejoy of WWF-US served as chief spokesman for the international conservation community. Dr. R. M. Pyle represented the Lepidoptera Specialist Group of IUCN. Mexican biologists and government authorities at every level, many of whom are here today, cordially received these visitors and tutored them in the complexities of Mexican land management. Our primary liaison with the academic community was Professor Dra. Leonila Vazquez, Mexican representative to LSG with her colleague Maestro Hector Perez. Javier de la Maza, President of the Sociedad Mexicana de Lepidopterologia (and now Head of the Office of Habitat) served as federal liaison. Governor Cuauhtemoc Cardenas, his Forestry Chief Ing. Alberto Cruz and other officials warmly welcomed these delegations to the State of Michoacan. Lic. Rodolfo Ogarrio, President of Monarca, A.C., kindly offered that organization's facilities for meetings, conferences and social gatherings.

These discussions laid the groundwork for substantive proposals involving land reservation alternatives and alternative economic planning. All participants in the ongoing Monarch talks reached concensus on two basic points:

1) The overwintering grounds and all other ecological needs of the Monarchs must be saved if at all possible;

2) Alternative income, probably tourism-derived, must be

[1] Current address: Swede Park, 369 Loop Road, Gray's River, Washington 98621 USA

found for villagers standing to lose revenues due to protection of forests for the butterflies.

Individuals and organizations differed on specific approaches to the conservation plan, suggestions ranging from large parks to small, proscribed reservations surrounded by buffer areas of limited management options. However, everyone clearly favored maximum protection for the butterflies with minimum human economic disruption, however that might best be accomplished. While much remained to be worked out, participants in the international Monarch talks have come away hopeful that solutions could be found for both people and butterflies in the wintering areas. It is in this spirit that we convene in Cocoyoc, to carry the cooperative effort one step further.

CONCLUSION

The Monarch butterfly is far from being an endangered species. Introduced to many lands, resident in both Old and New World tropics, it has proven an adaptive colonizer given milkweed, warm climates and human assistance. However, the migratory Monarch and its great winter masses most definitely must be considered to be threatened and perhaps endangered. At risk is the grandest butterfly spectacle of all, and one of the most intriguing and mysterious of all animal migrations. For this reason, IUCN and WWF have erected a new red data category to account for the Monarch's unusual plight: Endangered Phenomenon.

Danaus plexippus may be considered the *de facto* "national butterfly" of the United States. It is surely the best known American butterfly, beloved by all and familiar in its life cycle to every schoolchild. Californians rightly consider their Monarchs to be a special cultural as well as economic treasure, celebrated in every way from Beach Boys' songs to granite statuary and parades. Yet, southern Canada enjoys the presence of summer Monarchs as well, in large numbers over a vast area. Point Pele in Ontario offers one of the most rewarding of all observation points along the migratory pathway, as Monarchs swell in numbers before crossing Lake Erie. And of course Mexico hosts the greatest masses of Monarchs in her montane fir forests. Each of these countries shares in the legacy of the migratory Monarch, the zenith of North American insect evolution. Yet each nation also shares the responsibility for preserving that legacy; no one of them can do it alone.

So it is that the Monarch presents us with a splendid opportunity for international cooperation. All relevant agencies, treaties and organizations should become deeply involved, performing the function for which they are best suited. There is room and need for all. The nectar resources along the way must be perpetuated; the crucial research to tell us how to manage Monarchs must be funded and carried out; tourism must be planned, capitalized, supervised and monitored so as to bring in revenues without killing the golden geese; and so many other tasks, from survey to interpretation, from politics to policing, all must be performed. There is no room for jealousy or territoriality, rather there is a powerful mandate for symbiotic action. Only in this way have we a chance to save the Monarch as the natural phenomenon we know and love today. If the Cocoyoc conference serves as any indication of the sort of partnership we can expect, then the future of La Monarca throughout the continent looks bright indeed. Let us all work together toward that goal.

UPDATE AND EPILOG

Since the Cocoyoc conference, further international delegations have travelled to Mexico to advance the conservation work. In January, 1983, the team met with Subsecretary of Ecology Dra. Alicia Barcenas, who has the task of personally overseeing the federal government's Monarch programs. She assured us that a viable system of Monarch reserves would be a high priority of the government, insofar as alternative economic sources can be developed for the local people who stand to lose logging income. State officials corroborated their dedication toward the same goal, and we met with biologists currently surveying the ground for reserve boundaries.

In February, 1983, HRH Queen Elizabeth and The Duke of Edinburgh visited Mexico. HRH Prince Philip, in his capacity as President of World Wildlife Fund, discussed the international interest in Monarch conservation with President de la Madrid. Prince Philip conveyed the support of the international conservation community for the efforts of Mexico's government on behalf of Monarch habitat protection. Similar sentiments were conveyed to Governor Cuauhtemoc Cardenas when the Royal Party visited Michoacan.

Subsequently, WWF-US increased their financial support to the Monarch project, enabling day-to-day supervision and coordination of Monarch activities in Mexico.

In the spring of 1983, the first *Invertebrate Red Data Book* of IUCN/WWF/UNEP (compiled by S. M. Wells, R. M. Pyle and N. M. Collins) was published. It contains data sheets on both Mexican and Californian Monarchs as Threatened Phenomena of worldwide importance. Summarizing their contents, a set of restrictively managed habitat reserves in Mexico is required as soon as possible; and a survey of all California sites, followed by sound protection of as many as possible, must be carried out.

International efforts shall continue toward the realization of these broad objectives. Thereafter, constant worldwide attention will be focused on these sites as more and more people become personally familiar with them. This will allow income to flow into the Monarch regions, supplanting lost forestry and development revenues, and calling for other kinds of careful development and associated jobs. Constant vigilance and scientific management will be crucial for maintaining the integrity of the mountain and coastal ecosystems of which the Monarchs form such a dramatic part. The challenge is a large one. Surely, the combined resources and determination of all those who care about Monarchs, on all sides of all borders, can meet that challenge.

NOTICE

With Robert M. Pyle as Honorary Chairman, Lincoln P. Brower as Honorary Director of Scientific Research and Melody Mackey Allen as Project Director, The Monarch Project is being launched as a project of the Xerces Society. The goals may be stated thus: "To help conserve the phenomenon of the migratory monarch butterfly through scientific research, policy support, economic alternatives and appropriate land management." Advisors to the project so far are Paul Ehrlich, Dillon Ripley, Jo Brewer, Sir Peter Scott, Roger Tory Peterson, Mike Morris and Rodolfo Ogarrio; The Nature Conservancy International Program, International Fund for Animal Welfare and Monarca A. C. have agreed to be Supporting Organizations at this date. As a fully international program, there will be honorary posts of Mexican, Californian and Canadian Coordinators: Fernando Ortiz Monasterio, John Lane, and Mary Lee Stephenson will hold those positions. Richard Lindley will be International Liaison.

ATALA

Volumes 10-12, 1982-1984(86)

THE XERCES SOCIETY

An international, non-profit organization dedicated to the conservation of terrestrial arthropods and their habitats. Named for the extinct Xerces Blue Butterfly, *Glaucopsyche xerces* (Boisduval). Founded on 9 December 1971.

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Membership in the Xerces Society is open to all interested persons and institutions upon submission of appropriate dues. Adult memberships are US $15.00, institutional subscriptions $25.00, student $10.00, retired $10.00, supporter $35.00, patron $150.00, benefactor $300.00, and life $1,000.00 for the 1985 calendar year. All members and institutional subscribers normally receive the journal *Atala* twice yearly; the less formal newsletter *Wings* three times yearly; *Self-Help Sheets* (informal, how-to articles) and *Educational Leaflets* (short, informal, informational) irregularly, as they are issued; and Society meeting announceents, membership lists, and other communications. Xerces Society publication and administration costs are covered by dues and contributions, all of which are tax-deductible. Members outside North America please include an additional $5.00 to cover overseas mailing expenses. A person or institution interested in receiving Xerces Society publications should submit name, address, and appropriate dues to the Treasurer, *David G. Furth, Entomology Division, Peabody Museum, Yale University, New Haven, CT 06520, USA.*

Changes of address, requests for back issues of all publications, and general correspondence about the Society should be sent to the Secretary, *Lawrence F. Gall, Entomology Division, Peabody Museum, Yale University, New Haven, CT 06520, USA.* Correspondence about terrestrial arthropod conservation issues and Xerces Society policies should be addressed to either the President, *Mary Hathaway, 8 Laurel Avenue, Somerville, MA 02143, USA,* or the Executive Director, *Melody M. Allen, 10 Southwest Ash Street, Ortland, OR 97204, USA.* Suggestions for *Self-Help Sheets* and *Educational Leaflets* and miscellaneous publications can be addressed to the President, *Atala* contributions should be mailed to the Editor, *Lawrence F. Gall, Entomology Division, Peabody Museum, Yale University, New Haven, CT 06520, USA.* Less formal items for inclusion in the Xerces Society newsletter *Wings* should be addressed to the Editor, *Larry Orsak, Department of Entomology, University of Georgia, Athens, Georgia 30602, USA.* Questions, comments or contributions to the annual Butterfly Count should be sent to the Butterfly Count Coordinator, *Paul A. Opler, Editorial Office, Room 259, Aylesworth Hall, Colorado State University, Fort Collins, Colorado 80523, USA.*

Published at Los Angeles, California, USA, in February 1986 by the Xerces Society in cooperation with The Lepidoptera Research Foundation.

ATALA

JOURNAL OF THE XERCES SOCIETY

Volumes 10-12 **1982-1984(86)**

Editorial Note

A few explanatory words are in order for this *Atala*. At their 1984 meeting in Albany, New York, the Xerces Board of Directors confronted the problem of publication tardiness during the past several years. Although the Society's most recent *Atala* — the superb bilingual Monarch Butterfly volume — was distributed late in 1984, that volume (9) had originally been slated for publication in 1981. In Albany, the Board weighed their concerns about journal promptness, manuscript availability, and the inevitably large work load of voluntary editors, and authorized publication of a single "catch-up" tome, Volumes 10-12 (1982-1984) inclusive.

Time constraints subsequently forced Dr. Pyle to step down in early 1985 from his productive tenure as *Atala* editor, and I assumed responsibility for the journal at that time. This jointly prepared *Atala* represents the "catch-up" tome authorized by the Board in 1984. Both numbers of the regularly scheduled 1985 Volume 13 are now in production, and slated for publication (perhaps as a combined issue) in early 1986. Thus, with good luck, the Society's journal should be brought current by the end of 1986.

As it ecloses anew with Volume 13, *Atala* will be attempting to broaden its base by soliciting papers on a wider diversity of invertebrates, and facilitate the electronic transmission of manuscripts. The *Atala* editorial staff can at present handle essentially any manuscript sent as a file over the mainframe networks ARPANET and BITNET, as well as files on diskettes produced by word-processing software on IBM microcomputers or Macintoshes. Interested authors should contact one of the staff for further details and hints on transmitting via computer, and help *Atala* to come of electronic age! — L.F.G.

Articles

BIOLOGY AND ECOLOGY OF *PARIDES ASCANIUS* (CRAMER, 1775) (LEP., PAPILIONIDAE), A PRIMITIVE BUTTERFLY THREATENED WITH EXTINCTION

Luiz Soledade Otero[1] and Keith S. Brown, Jr.[2]

1. Departamento de Entomologia, Museu Nacional, U.F.R.J. Quinta da Boa Vista 20.940 Rio de Janeiro, RJ BRAZIL

2. Departamento de Zoologia, Instituto de Biologia, Universidade Estadual de Campinas, C.P. 1170 13.100 Campinas, Sao Paulo BRAZIL

ABSTRACT

Because of extensive destruction of its restricted habitat through draining and urban development, *Parides ascanius* (Cr.) (Papilionidae:Troidini) (= *Battus orophobus* D'Almeida), an inhabitant of subcoastal and lowland swamps in Rio de Janeiro, Brazil, has been placed on the official list of Brazilian animals threatened with extinction. *P. ascanius* is very close systematically to the allopatric *P. bunichus*, but shows consistent differences in size, foodplant usage, and juvenile morphology; the two species did not hybridize under free encounter (virgin females) or hand-pairing conditions. *P. ascanius* occurs very locally in sea-level swampy thickets on turf-sandy soils where its only known foodplant, *Aristolochia macroura* Gomez, grows abundantly. Twelve other species of *Aristolochia* tested gave no adults and little if any larval growth, and very rarely elicited oviposition in *P. ascanius*. Adults range widely in the open searching for flower resources (mostly Verbenaceae and Compositae), and are accompanied by several potential Batesian mimics; the closest is *Graphium lysithous harrisianus* (Swainson), now on the verge of extinction. The occurrence of *P. ascanius* in the Poco das Antas Biological Reserve (5000 ha, with several colonies) may guarantee its future preservation; it is also present in other small preserved areas and one proposed "restinga" reserve, and should occur in large inaccessible lowland swamps in northeastern Rio de Janeiro. Theoretical considerations and field data on Neotropical butterfly diversity and abundance in relation to mild habitat disturbance suggest some guidelines for management of *P. ascanius* and other threatened butterfly species of tropical forests.

Introduction

The strikingly beautiful black, white and rose swallowtail of the coastal swamps of Rio de Janeiro, SE Brazil, *Parides ascanius* (Cramer, 1775) (Figure 1), has been illustrated in many popular and scientific works published on Neotropical butterflies. Because of increasing "development" pressure on its habitat, much of it near the megalopolis of Rio de Janeiro or neighboring beach resorts, it has become increasingly scarce in this century; many of the colonies where the authors and others observed it frequently before 1970 no longer exist. In an executive action (3481-DN) on May 31, 1973, the Brazilian National Parks agency (through the IBDF, Brazilian Institute for Forest Development) placed *P. ascanius* (using the later synonym, *Battus orophobus* D'Almeida) on the official list of Brazilian animals threatened with extinction. There it remains as the only insect presently acknowledged this status.

The distribution of *P. ascanius* has probably always been restricted and spotty. The inaccessibility and inhospitability of its habitat (swampy, mosquito-infested subdune thickets in the complex formation known as "restinga", and other dense lowland wooded swamps) kept many of its colonies safe from collectors and developers until recently. At present, with the growing population of the state of Rio de Janeiro, the coastal and lowland swamps are being drained and turned into urban and recreational subdivisions, banana plantations, or pasture, from one extreme of the known range of *P. ascanius* to the other (Figs. 2-3). Only one major conservation unit exists within this range (Fig. 3); other protected areas are insufficiently large to maintain even a single viable colony of the species.

The biology and ecology of *P. ascanius* have but rarely been mentioned in the literature, although Burmeister (1879: 8) gave a brief sketch of the early stages from information received from his son; Foetterle (1902: 622) considered its sun-loving and forest-shunning behavior and heavy flight as similar to those of the closely related *P. bunichus diodorus* (Hopff.) (Fig. 4c) (which he called "*P. campeiro*"); and D'Almeida (1922) described (without illustrations) the early stages obtained from eggs expressed from females (not naming the foodplant, which from the reported development schedule and larval-pupal measurements must have been poorly accepted), and briefly discussed adult periodicity and behavior. A summary of known information, with greater details on behavior, periodicity, and larval food, was given by D'Almeida (1966); he concludes his essay by remarking that the species "perhaps very soon will disappear from the Rio de Janeiro area, due to the destruction of the forests and resulting elimination of the *Aristolochia* plants which inhabit the low swamps of the Atlantic coast, unless measures be taken for restoring the vegetation of these areas."

This paper unites the information presently available on *P. ascanius*, including systematics, morphology, geographical dis-

Figure 1. *Parides ascanius*, male, dorsal (left), Restinga de Jacarepagua, Rio de Janeiro, Brazil; female, dorsal and ventral (right), Parque Santa Dalila, RJ. Scale (below insects) in cm.

tribution, juvenile biology, adult behavior, and ecological relationships including foodplant acceptance, and supports the establishment and maintenance of reserves on northeastern Rio de Janeiro, which have sufficient size and proper habitat to help in avoiding the continued decline in populations of this much-admired and evolutionarily important butterfly.

Systematics and Adult Morphology

Papilio ascanius Cramer, 1775 is a putative stillborn homonym of *Papilio ascanius* Linnaeus, 1762 (D'Almeida, 1966: 343). Two substitute names have been proposed, *Battus (Parides) orophobus* D'Almeida, 1942 and *Papilio neascanius* Toxopeus, 1951. However, in a singular action in 1954, the I.C.Z.N. (Opinion 265), following a suggestion of Corbet, placed *P. ascanius* Linnaeus, 1762, a senior synonym of *P. aristolochiae* Fabricius, 1775 (now known as *Atrophaneura (Pachliopta) aristolochiae*, an Indo-Australian relative of the South American *Parides*), on the Official List of Rejected Names, and *P. aristolochiae* and *P. ascanius* Cramer, 1775 on the Official List of Specific Names. Thereby, both of the latter names are retained in their most widely known and used senses, and *orophobus* and *neascanius* become junior synonyms of *ascanius* Cramer.*

Parides ascanius is very close in adult morphological characters, including genitalia and minor elements of wing color-pattern, to *P. bunichus* (Figure 4b),** a widespread polytypic species of central Brazil to northern Argentina (Fig. 2). It is not uncommon to capture *P. b. bunichus* in central Sao Paulo state with very wide white bands or extensive pink color at the hindwing anal margin as in *P. ascanius*, and narrow-banded *P. ascanius* are known with reduced pink on the hindwing; these suggest possible introgression in nature, or at least shared ancestral genes. The appreciable differences in early stages (below) and the indifference of males of each species with respect to virgin females of the other, however, suggest that the union of the two species is inadvisable. Two other "species" following D'Almeida (1966) are here united with *bunichus* (*P. perrhebus* (Bsdv.) (Fig. 4d) and *P. diodorus* (Hopff.) (Fig. 4c)), since they clearly intergrade and interbreed with *bunichus* over wide zones of co-occurrence and also in the laboratory (Fig. 2). *P. ascanius* is totally isolated from *P.b. bunichus* by the deep forests of the seaward slope of the Serra do Mar (Fig. 2), which *bunichus* has never been seen to penetrate and up which *ascanius* is not known to ascend. A further species, *P. phalaecus* (Hewitson) of eastern Ecuador (Fig. 2), is also very close to *P. bunichus* (see Fig. 4e) and suggests a former very wide range for this group of three species in more open vegetation formations in South America.

Habitat and Known Colonies of *P. ascanius*

The *ascanius* group of species is presently divided into vicariants with respect to morphoclimatic domains (Table 1), always preferring more sunny and even xeric habitats. They are therefore unlike other *Parides* including their closest relatives in the *ascanius*-group of Rothschild and Jordan (1906); but the Mexican species *P. alopius* has also been reported in non-forest habitats, and *P. montezuma* and *P. photinus* can tolerate such habitats though they distinctly prefer humid and shady areas for oviposition (see Rausher, 1979). Some races of *P. anchises* also occur in very xeric habitats in Colombia, Venezuela and central Brazil. One of the closest relatives of *P. ascanius* and the only member of the genus which we consider more primitive than it, *P. proneus* (Fig. 4f), is widely sympatric with *P.b. bunichus* in the interior of southeastern Brazil (Fig. 2), inhabiting both forests and somewhat more open vegetation, though strongly preferring the former and laying its eggs on a single foodplant of the moist shady understory, *Aristolochia melastoma* Manso (see Brown, Damman and Feeny, 1981).

The areas where *P. ascanius* has been found in this century, including once-thriving colonies now apparently extinct and showing well-collected ideal swampy habitat where the species has never been captured, are shown in Fig. 3. The farthest northeast confirmed colony is near Atafona, on the south bank of the Rio Paraiba do Sul where it meets the Atlantic Ocean. An old record exists for Marataizes, in southern Espirito Santo, but we did not find any *ascanius* in recent trips to this region, which has rather little suitable swampy habitat. The farthest southwest confirmed colony is in the Muriqui region just west of Rio de Janeiro. Extensive searches have not yet found any *ascanius* farther southwest in eminently ideal habitat, with abundant foodplant, near Angra dos Reis, Ubatuba, Caraguatatuba, Sao Sebastiao (*fide* P. Muller, Saarbrucken), Pauba, Bertioga, Guaruja, Praia Grande, Mongagua, Peruibe, Guarau, Barra da Una, Iguape, Ilha Comprida, Pariquera-Acu, or Registro, nor confirmed the population reported from Santos (Sao Paulo) by D'Almeida (1966) (Fig. 3). West of Muriqui and throughout the state of Sao Paulo, the coastal mountains often close against the sea for long stretches, leaving only small areas of lowland available for colonization (Fig. 3). Even the extensive coastal restingas and swamps of the Iguape-Registro region of southwestern Sao Paulo show, like all other coastal habitats west of Muriqui, many mountain species of butterflies and plants not known from the broad Rio de Janeiro coastal plain. Essentially all these habitats are much more cold and humid than known *ascanius* localities in Rio de Janeiro; they have been classified as subtropical, and are very possibly unsuitable for colonization or maintenance of *P. ascanius*.

*Prof. Olaf Mielke of Curitiba has called our attention to the fact that this singular opinion of the ICZN does not necessarily require the resurrection of the junior homonym *Papilio ascanius* Cramer and sanction its use, since the Zoological code does not specifically eliminate rejected names from competing in cases of homonymy. However, since the Opinion 265 placed the "automatically rejected" junior homonym *ascanius* Cramer on the Official List of Specific Names and rejected the senior homonym instead, we follow its intent and action in using *ascanius* for this species. Those who cannot accept Opinion 265 with its apparent contradiction of Articles 53 and 59a of the code, should use the name *orophobus* D'Almeida for the species we call *ascanius* in this paper.

***P. bunichus* (Hübner, 1821: Samm Exot. Schmett. II, Plate 103, Figures 3-4, January) is frequently known by the slightly younger name *P. chamissonia* (Eschscholtz, 1821); the latter was used by Rothschild & Jordan (1906) and followed by later authors, due to uncertainty in the Hübner date (see D'Almeida, 1966).

Figure 2. Known ranges of *Parides* species and subspecies allied to *P. ascanius*. Overlapping shading indicates regions of character intergradation for different subspecies of *P. bunichus*.

In swampy parts of the coastal plain of Rio de Janeiro, especially with scrubby vegetation along low river valleys, *P. ascanius* has been found as much as 30 km inland (Fig. 3), but it never appears in forested regions of the foothills of the Serra do Mar (unlike the other coastal endemic, *P. zacynthus*, which frequently penetrates the foothills; this may explain its distribution from Rio Grande do Norte to Santa Catarina along the Brazilian coast).

Within its range, *P. ascanius* is at best very sparsely distributed; when a colony is present, the species may be common in certain seasons (up to 50 individuals seen in a single morning), so it is unlikely that important additional colonies remain undiscovered in presently accessible regions. It is best sought in areas with periodically or permanently waterlogged turf-sandy (organic) soils, low thorny thicket to open palm forest vegetation (Fig. 5b) including much larval foodplant (*Aristolochia macroura* Gomez), and continuously abundant favored flowers for adult resources, from beachside inwards to the base of the first dense forest or elevated rolling terrain (Fig. 5a). It has not been seen in mangrove swamps, in subdune scrubby restinga with cacti present, in pure dune vegetation, in tall forests on non-floodable ground of the coastal plain (even when on a terrace only a few meters above sea level), on any fine-grained or well-drained soils, or in rolling terrain. Its ideal vegetation is very patchy in the Rio de Janeiro coastal plain (Fig. 5), depending upon narrowly defined combinations of climate, soils, drainage, vegetation light structure, and presence of certain plant species.

Juvenile Biology

The early stages of *P. ascanius* were obtained and reared initially in an outdoor flight cage (2 x 4 x 2.5 m) located in humid restinga vegetation (originally) in Barra da Tijuca, Rio de Janeiro (house of the first author). Shoots of *Aristolochia macroura* Gomez (Fig. 6) in water glasses, or plants in vases, were placed at different levels above the ground, and served as substrate for oviposition by females. As many as 30 adults were maintained simultaneously in this cage. For controlled oviposition of individual females, hermetically sealed transparent plastic boxes (20 x 20 x 20 cm) or bags of the same size with foodplant shoots and ropes were used; the females were fed honey water (1:5) and placed in the boxes or bags under conditions of fairly strong diffuse light and elevated temperature (30-40° C.), which promoted abundant oviposition in this and many other (but not all) *Parides* species.

A female was captured in nature (Jacarepagua, Rio de Janeiro) by the first author on 2 November 1979; confined in a plastic box with *A. macroura* and fed daily, she produced 173 eggs during 11 days. A further female captured in nature on 8 November 1971 was initially confined in a box with *A. macroura*; she laid 49 eggs on 8-9 November, and was then sent to Campinas, where she was placed with Sao Paulo (Praia do Pereque, see Fig. 3) *A. macroura* and laid another 83 eggs between 11 and 20 November, when she died with many near-mature eggs still in her abdomen. She was fed twice or thrice daily, placed in a plastic bag and subjected to heat and light in the afternoon; she was also used for testing

oviposition preferences on alternate days (see below).

Another female emerged from the pupa on 11 November 1980, and was hand-paired on the same day (between 11:30 and 12:30) to a field-captured male from the nearby restinga. She was then placed in the plastic box and fed daily with honey water. She laid a total of 33 eggs on the foodplant and on the sides of the box between 13 and 19 November, and another 12 (total 45) before she died on 23 November; ten near-mature eggs were encountered in her abdomen. This suggests a lower fecundity for adults reared in captivity, with relation to those found in nature.

Description of early stages, always in comparison with the close relatives *P. bunichus* (Fig. 4b) and *P. proneus* (Fig. 4f), follows (see also Table 2 and Fig. 7).

Egg (Fig. 7a)

Average diameter 1.7 mm (min. 1.6, max. 1.9, N = 139; the average may vary 0.1 mm between different females). An irregularly sculptured spheroid with 14-16 ridges, covered by the female with a hard lumpy mass which the newly hatched larva consumes immediately (Fig. 7b). Eggs expressed from the abdomen are smooth spheres (uncoated) and rarely hatch, indicating that both the fertilization and the coating are applied by the female at the time of oviposition (which delays many seconds, while the female maintains her wings in motion, holds on to the upper surface of a leaf or a stem, and lays under the leaf or on nearby objects). Duration 8 days (many 7 or 9 days; extremes 5 to 11).

Larva (Figures 7b-d)

First instar covered with long, fine setae (Figs. 7b-d), which become raised on pointed tubercles as the larva grows. By the end of the instar, the tubercles show the characteristic light and dark pattern of the mature larva. Average length before molt 6.3 mm (min. 5.2, max. 7.5, N = 26); average head capsule width 0.9 mm (min. 0.8, max. 1.0, N = 44). Light in color (especially terminally) when hatched, becoming gradually darker (especially on head and thorax) in first two days. Usual duration on *A. macroura*, 4 or 5 days.

Second instar through fifth instar larvae (Figs. 7 e-l) progressively larger and more clearly marked with whitish-yellow tubercles and a side streak of the same color (appears in very late third or early fourth instar); ventral light tubercles appear only in the third or fourth instar; tubercles maintain a nearly constant relation to head height (about 50-70%). The average length before molt, average head capsule width, and average duration of each instar on *A. macroura* are given in Table 2, along with the number examined in each case.

Fifth instar (Figs. 7 i-l) mottled dark red-brown (versus nearly black in *P. bunichus* (Fig. 7 m), mottled gray-brown in *P. proneus* (Fig. 7 n), with subequal tubercles over 50% of head height (versus less than 40% in *P. bunichus* and *P. proneus*, with darker tubercles still shorter in latter). A broad light side streak runs from the light dorsolateral tubercles on the fourth abdominal segment to the base of each proleg on the third, including the light subspiracular tubercle on the third segment. The light-colored tubercles and the stripe are creamy yellow in color like those of *P. proneus*, not dark yellow to orange as in *P. bunichus*. Light-colored tubercles are found on the prothorax (sublateral and ventrolateral), mesothorax (dorsolateral and ventrolateral; supralateral and sublateral tubercles dark), second through sixth abdominal segments (ventrolateral, just above the prolegs; not

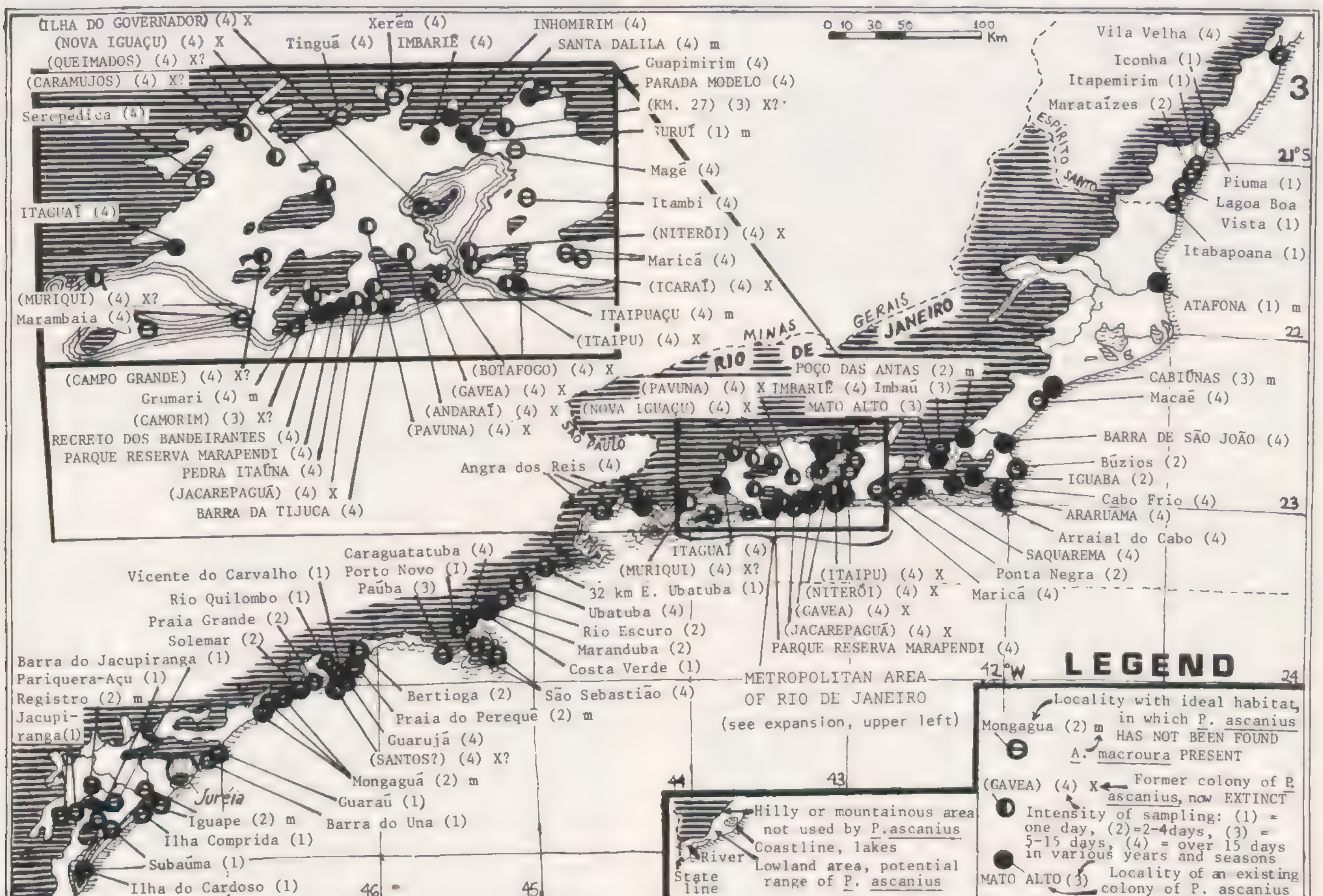

Figure 3. Colonies (present and former) of *P. ascanius*, and additional areas visited with ideal habitat where the species has not been seen. In upper left, detail of the metropolitan area of Rio de Janeiro, where most colonies have been or are rapidly being replaced by urban growth.

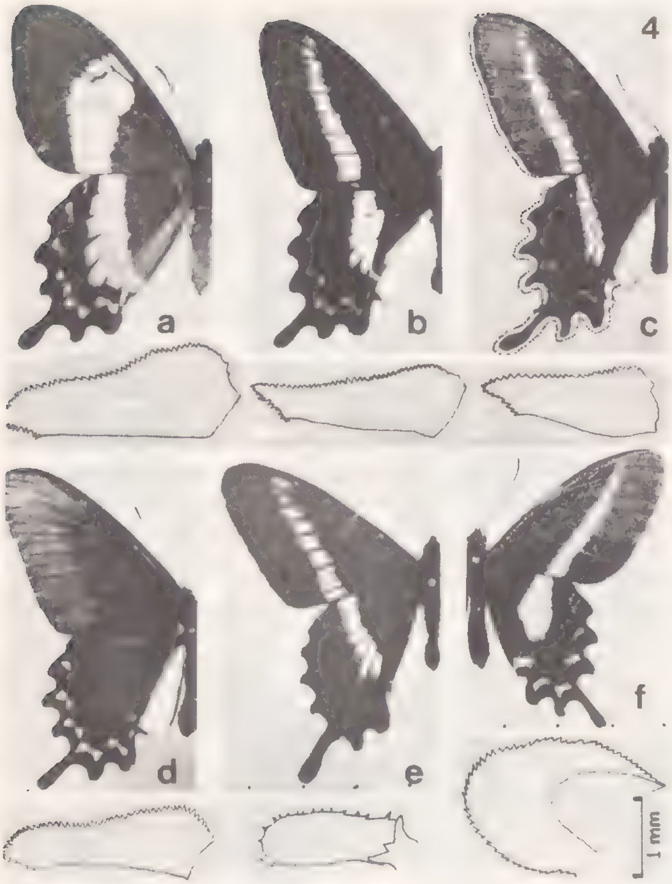

Figure 4. *Parides* species allied to *P. ascanius*. Below each insect is a drawing of the male genital harpe (scale at lower right); the harpes, widely used in Papilionid systematics, are processes on the inner face of the valve (right ones are shown, with the valve tip to upper left). **a,** *P. ascanius*, female, Restinga de Jacarepagua, RJ; **b,** *P. b. bunichus,* male, Sumare, Sao Paulo; **c,** *P. B. diodorus*, narrow-banded male (from introgression with *P. b. bunichus* and *P. b. perrhebus*??), Belo Horizonte, Minas Gerais; **d,** *P. b. perrhebus,* male, Agrolandia, Santa Catarina; **e,** *P. phalaecus,* male, Loja, Ecuador (Allyn Museum, Sarasota, photo by J. Y. Miller); **f,** *P. proneus,* female, Sumare, Sao Paulo (the sclerotized and toothed male harpe occupies the entire inner face of the valve in this species). Scale under butterflies is in cm.

Figure 5. Habitats of *P. ascanius.* **a,** view of the Restinga de Jacarepagua, Rio de Janeiro, looking west from Pedra Bonita (700 m), to the northeast of Barra da Tijuca, at left. Recreio dos Bandeirantes is at the back (two shortest indicator arrows). Note scattered patches of swampy thicket in the mostly open complex of dunes, lagoons, dry restinga and high forest on dry terrain. Known colonies of *P. ascanius*, most either extinct today or condemned by draining and building, are indicated by vertical lines. The broad flat humid sand/water system known as "restinga" is formed, in Rio de Janeiro state, by accumulation of sand between two headlands (left, and center rear), with eventual enclosure of lagoons, and represents a perennially unstable system with many characteristic vegetation types. **b,** view of a lowland swampy thicket of the sort often inhabited by interior (coastal-plain) populations of *P. ascanius,* on poorly drained but sandy soil enriched by clay runoff from neighboring hills (from which photo taken). This area in Barra do Jacupiranga (Sao Paulo) did not seem to have any *ascanius* present. Note the uneven and low canopy, unstable in space and time; the edge of the open marsh in the foreground; the higher trees covered with Spanish moss (left), and the tortuous trunks and branches. *P. ascanius* is best sought on abundant flowers which occur along the edges of such nearly impenetrable habitats.

known to be light in any other *Parides* larvae), seventh and ninth abdominal segments (dorsolateral and subspiracular, with broad light bases, the same pattern as observed in *P. bunichus* but no other *Parides* larvae), and tenth abdominal (anal) segment (beside the subspiracular tubercles of the ninth segment), in addition to those in the side stripe. There may also be a light subspiracular spot on the fifth abdominal segment. The over-all impression is that of a larva organized in a fashion similar to that of *P. bunichus* (Fig. 7 m) rather than *P. proneus* (Fig. 7 n), but strongly different from the former.

Prepupa (Fig. 7 o) lighter in color (streaked grayish-brown); hangs for nearly two days before final molt.

Pupa (Figs. 7 p-r)

Always brown-yellow in color (can be either green or light brown in *P. bunichus* and *P. proneus*), very similar to *proneus* pupa (Fig. 7 s) although somewhat smoother, but still with more salient projections than the very smooth pupa of *P. bunichus* (Fig. 7 t). Short conical projections on fifth and sixth abdominal segments, dorsolaterally; barely salient on seventh and eighth segments (all are absent in *P. bunichus*). No trace of the red dorsolateral spots on the first abdominal segment, prominent in pupae of *P. bunichus* subspecies. Duration 18 days; on the last day, the pupa shows the adult color-patterns through the wing and abdominal cases (Fig. 7 u). Emergence is in the morning and very rapid, with wing expansion complete in less than five minutes (Figs. 7 v-w); the wings then take several hours to harden enough to permit flight. Mating usually occurs on the same day (males can also mate on the day of eclosion) and oviposition of females begins within a day or two.

Total duration of early stages, 58 days (8 egg, 32 larva, 19 pupa) in Campinas climate, as little as 50 days in Rio de Janeiro. Pupal diapause is not uncommon (especially in cool weather) and can last up to 60 days, thus "skipping" a complete generation period (the midwinter generation is very small).

Under identical conditions to the *ascanius* rearing in Campinas, native *P.b. bunichus* completed juvenile development equally well on *A. macroura* (not known to the species), *A. arcuata* and *A. melastoma* (preferred natural foodplants), in 47 days, using 1-2 days less than the larger *P. ascanius* in each stage (Table 2).

Early stages of *P. ascanius,* as of other Troidini, are but rarely subject to parasitism. We have seen only one parasitized egg in nature (Fig. 8a, apparently *Trichogramma*), and once

reared a Braconid wasp from a larva emerged from a third instar larva (Fig. 8b); Tachinid flies have also been obtained from *P. bunichus* in Campinas, and other Hymenoptera from late instar larvae or pupae of other Troidini. Nuclear polyhedral virus and bacterial disease were very strong in closely confined juveniles (entire lots were frequently lost, even when reared individually and invariably when reared 2-4 to a closed dish) (Figs. 8 c-d), and are probably fairly important in control of natural populations during periods of excessive heat and moisture.

Food-plant Relationships

The only known host plant for *P. ascanius* in nature is *Aristolochia macroura* Gomez (Fig. 6), a species restricted in southeastern Brazil to sandy coastal "restinga" habitats and lowland swamps, but otherwise much more widely distributed than *P. ascanius*, at least from Bahia to Santa Catarina, also occurring in the north of Argentina far from the ocean. A closely related species (*A. trilobata* L.) is found in coastal northeastern Brazil to Colombia and the Antilles; see Hoehne (1942) for information on other relatives, such as *A. paulistana* Hoehne (mentioned below), *A. hypoglauca* Kuhlm., and *A. mishuyacuensis* Schmidt. As D'Almeida (1922, 1966) reared through two small and delayed *P. ascanius* presumably on *A. rumicifolia* var. *oblonga* (Vell.) Mast. growing in his garden, however (Table 2), we undertook experiments with other possible *Aristolochia* species, including those regularly available to *P. ascanius* in nature (marked with an asterisk below), to test oviposition and larval growth. The species investigated were (in approximate evolutionary order) *Aristolochia melastoma* Manso, *A. odora** Steud., *A. arcuata* Mast., *A. rumicifolia** Mart. et Zucc., *A. triangularis* Cham., *A. paulistana*?* Hoehne, *A. esperanzae* O. Kuntze, *A. cymbifera** Mart. et Zucc., *A. galeata* Mart. et. Zucc. (= *A. brasiliensis* Mart. et Zucc.), *A. elegans* Mast. (= *A. littoralis* auctorum sensu Pfeifer, *non* Parodi = *A. odoratissima* L.), and *A. gigantea* Mart. et Zucc. Four of the first five species mentioned (except *A. odora*) are highly suitable hosts for oviposition and larval growth of almost all Troidini (Brown, Damman & Feeny, 1981).

The results of the experiments are presented in Table 3. In captivity, females of *P. ascanius* very rarely laid eggs except in the presence of *A. macroura*, both in choice and no-choice situations. The female inspects the host-plant carefully, both visually and chemically (by drumming of the forelegs), before initiating the rather lengthy oviposition sequence which places the egg under a leaf (usually); however, she may lay eggs on nearby dry twigs or other supports. This presumably could help to avoid parasitism, predation, or cannibalism by older larvae (often observed in captive cultures of troidines); eggs off the host plants and away from its cues to enemies may have a higher survivorship, and newly emerged larva can wander far with the nutrients in the eggshell.

In the oviposition choice experiment in 1981, the female was first permitted to lay on *A. macroura*, producing in one day 19 eggs. She was then placed in a choice situation with *macroura* plus much larger amounts of fresh *A. arcuata* and *A. melastoma* (favored plants of *P. bunichus* in central Sao Paulo), and laid only 6 eggs, all except one on *macroura*. When the *macroura* leaves were removed, she refused to lay eggs for two and a half days, although the *arcuata* and *melastoma* were maintained fresh. Substitution of these plants with some old *macroura* stems and leaves resulted in an immediate discharge of eggs, reaching a total of 25 in three hours. This seems to be a very clear preference. In 1982, a female *ascanius* from inland swamps, where *A. cymbifera* is common, oviposited a few eggs on both *A. cymbifera* and *A. odora*, but most eggs were laid off the plants (on the bag). None of the 36 resulting larvae accepted *A. cymbifera* or its close relatives *A. esperanzae* and *A. galeata*, all dying before the first molt.

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Figure 6. *Aristolochia macroura*, the only known foodplant of larvae of *P. ascanius*. Closeup of decumbant branches (upper), branch growing up an older *Cecropia* plant (center, with 10-foliate leaves) (the *A. macroura* leaves are less deeply trifoliate than in the upper plant), and spreading out over open sand (lower).

In experiments to test acceptance of food-plants by larvae of *P. ascanius*, first instar larvae, recently emerged but already fortified with the nutrients in their eggshells, or later instar larvae already conditioned to *A. macroura*, were offered both choice and no-choice situations with the same spectrum of *Aristolochia* species (Table 3). Both consumption of the foodplant and larval growth and mortality were considered in the analysis, although constant environmental conditions were not available.

Mature larvae of *P. ascanius*, like all their congeners, chew extensively the stems of their foodplant before pupation, at times even snipping off and discarding leaves and tips. Although first instar larvae seem to prefer older leaves of *A. macroura* to fresh tips, they did not survive to the first molt when given only stems of the foodplant; some feeding was evidenced. From the first instar on, the larva of *P. ascanius* is always to be found underneath leaves, never on their upper side; fourth and especially fifth instar larvae wander widely over the foodplant and will search for new plants when they find no leaves or stems left on the one they occupy. The prepupa wanders extensively without feeding, usually choosing a pupation site well off the foodplant. If

Figure 7. Life cycle of *P. ascanius* (except **m, n, s,** and **t,** related species for comparison); scales in mm or cm for egg, larvae, and pupae indicated. **a,** egg (see also Fig. 8a); **b,** recently emerged first instar larva, dorsal, consuming egg coating; **c,** same larva, lateral; **d,** mature first instar larva in molt, lateral; **e,** second instar larva, lateral; **f,** third instar larva, lateral; **g-h,** fourth instar larva, lateral and dorsal; **i-l,** fifth instar larvae, dorsal, lateral, lateral, and detail of abdomen; **m,** fifth instar larva of *P. b. bunichus;* **n,** fifth instar larva of *P. proneus;* **o,** prepupa; **p-r,** pupa, lateral, dorsal, and dorsolateral; **s,** pupa of *P. proneus,* dorsolateral; **t,** pupa of *P. b. bunichus,* dorsolateral; **u,** pupa just before eclosion of adult (note forewing pattern showing through wing case); **v,** adult female 2 min. after eclosion; **w,** same female 10 min. after eclosion, drying expanded wings.

prevented from locomotion, it may form an inviable pupa.

From our results (Table 3), we must conclude that D'Almeida's rearing of *P. ascanius* on the *A. rumicifolia oblonga* growing in his garden was an exceptional case; this is supported by the long development times and small juvenile sizes reported (D'Almeida, 1922; see also Table 2). Like *P. proneus* but unlike *P. bunichus* or most of the more evolved *Parides, P. ascanius* seems to be an essentially monophagous specialist on its only known host plant, *A. macroura,* both in behavior and physiological tolerance. It may use the closely related *A. paulistana* if its occurs in the coastal regions of Sao Paulo, where this plant is common.

Adult Biology

P. ascanius males fly principally in the morning (600-1100) and late afternoon (1500-1800), in the sun and above the vegetation, searching for flowers; for this reason, colonies are not difficult to locate in the right season. Females also fly in the open at these times, and may also be found in the shade in the interior of thickets or forests, especially in the hotter hours of the day, resting or seeking foodplants for oviposition. In variable or inclement weather, *P. ascanius* can fly in the open at any time of the day, though infrequently.

In the flight cage, with natural (*Lantana*) and artificial (honey water) food, mean longevity for adults was 10 days (N = over 200), with a maximum of 14 days. This corresponds well with data obtained from *P. bunichus* and other species both in a growth chamber (protected from predators, ideal environment) and in the field (Brown, Damman and Feeny, 1981). The short adult lifespan and long (two-month) juvenile development period, possibly further organized by flower seasonality which permits greater egg production in periods of heavy blooms, may help to produce the six clear-cut annual generations usually seen in this and other *Parides* species in southern Brazil (D'Almeida, 1966; Brown, Damman and Feeny, 1981; Brown, in prep.).

Adults emerge from the pupa in the early morning, and females are usually mated on the same day. Two courtships and matings have been observed in nature, both in the restinga of Jacarepagua, Rio de Janeiro. One was at 1130 and the second at 1200. The first included an aerial phase, with a male dislodging a recently emerged female from a leaf of *A. macroura,* pursuing her for 50 m, landing on her left side with wings fluttering, curving his abdomen and joining it with hers, and after a few moments swinging around to a hanging position opposite to the female (who would presumably carry the male if flight was necessary, as in other troidines). The copula occurred two meters above the ground, in the shade, and lasted one hour. The second observation did not involve flight; a male directly approached a recently emerged female beside her pupa, four meters above the ground, in the middle of an *A. macroura* patch in the sun, and copulated with her.

Hand-pairing of *P. ascanius,* including of already-mated females, is not difficult (Fig. 9a); as with other *Parides,* a very small angle between the butterflies is necessary (bodies almost parallel). Male *P. ascanius* were also hand-paired, with some difficulty and occasional failure for particular pairs, to virgin and mated females of *P. bunichus* (Fig. 9b). The longest of these pairings lasted only half an hour; although spermatophore transferral was judged to have occurred and the female subsequently developed the sclerotic internal plug in the copulatory pore typical of mated *Parides,* all progeny of this female were typical *P. bunichus* in all larval, pupal and adult characters, implying that she had been previously mated to a male of her own species (she was field-caught and showed no plug before the hand-pairing).

The appreciably larger size of *P. ascanius* over *P. bunichus* in all structures, including genitalia, made hand-pairing of male *bunichus* to female *ascanius* more difficult. In one case where

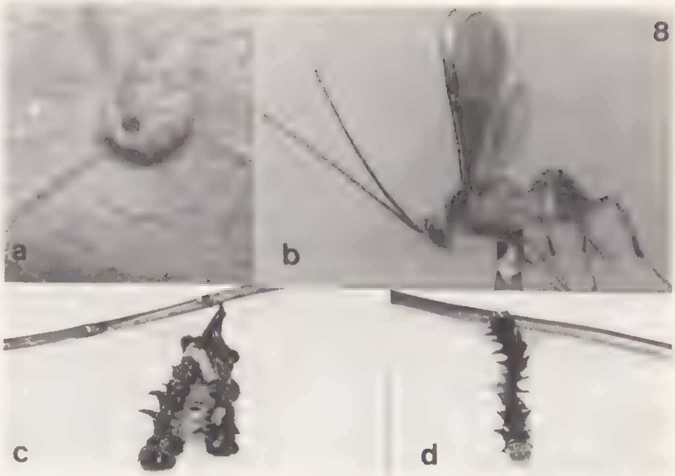

Figure 8. Natural control of *P. ascanius* populations. **a,** egg showing exit hole for parasitoids, presumably *Trichogramma* sp. (microhymenopterans); **b,** a braconid wasp (not yet identified) emerged, as pupa, from a third-instar larva; **c,** fourth to fifth instar molt, dead of virus infection; **d,** same in third instar.

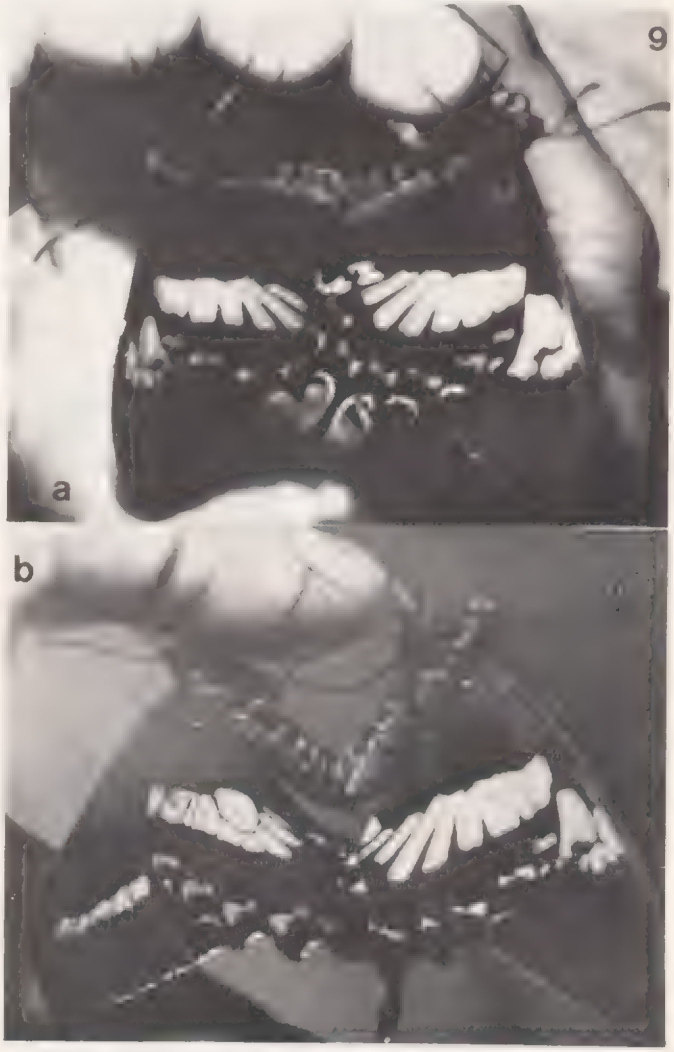

Figure 9. Hand pairing of *P. ascanius,* Barra da Tijuca, evening of Jan. 27, 1982, house of the first author. **a,** male (left) and young but mated female (right), both field-captured the same day in the Parque Reserva Marapendi, Recreio dos Bandeirantes, RJ; **b,** same male (right) and a young, field-captured but already mated female of *P. b. bunichus* from Campinas, Sao Paulo.

"locking" was obtained, the copula lasted only five minutes and all progeny were typical *ascanius* (again indicating that the field-captured but unplugged female had indeed been mated already; see note at end).

Hand-pairing did not seem to require specific chemical conditioning, but when interspecific appeared to be easier when the females were first "locked" for a minute or two with males of their own species.

These results suggest that *P. ascanius* and *P. bunichus*, closely related and allopatric, will show very low interfertility. Support for this prediction comes from the behavior of males of each species (both field-captured and reared) when presented with freshly emerged virgin females of the other in a sunlit, flower-filled flight cage. No interest, excitement, or courtship behavior was elicited in any such case. In the same cage, by way of control, a male *P.b. bunichus* rapidly courted and paired with a virgin female of the different-appearing *P.b. perrhebus* (Fig. 4d). We conclude that *P. ascanius* and *P. bunichus*, substantially differentiated morphologically, have also attained the level of good biological species, and thus do not represent threats of genetic introgression or swamping of each other, should they become sympatric in future modified environments.

Preferred flowers of *P. ascanius* adults in nature include especially Verbenaceae (*Lantana* and *Stachytarpheta*, which flower during all (the former) or most (the latter) of the year and are the principal sustainers of most known colonies today); various seasonal Compositae (*Vernonia, Mikania, Eupatorium, Elephantopis*); some high trees like *Inga* (Leguminosae) and *Chorisia* (Bombacaceae), in season; and occasional bursts of blooms of *Cestrum* (Solanaceae), *Carica* (Caricaceae), *Psychotria* (Rubiaceae, usually in habitat too strongly shaded for *P. ascanius*), and *Urena* (Malvaceae). Garden butterfly flowers such as *Buddleja* (Loganiaceae), *Zinnia* (Compositae), and especially various Verbenaceae, would be useful in sustaining populations of *P. ascanius* in semi-developed areas where the foodplant still persists in local swamps.

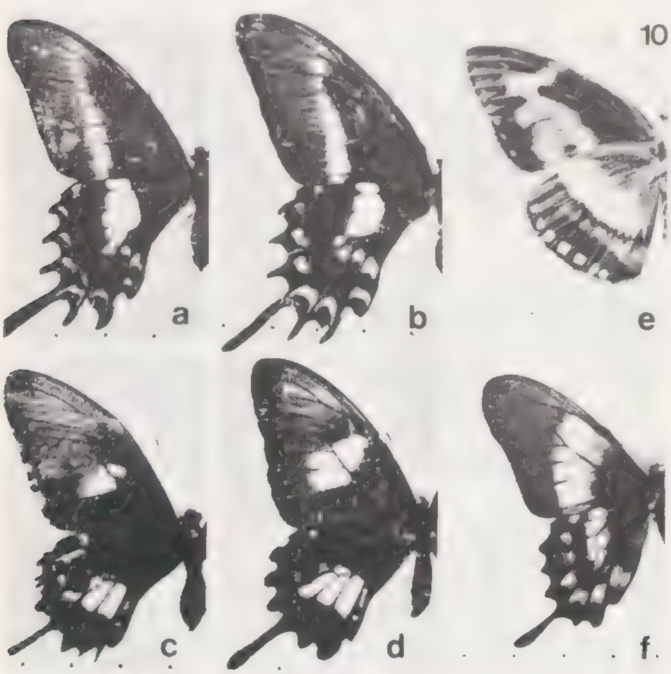

Figure 10. Potential Batesian mimics of *P. ascanius*. **a**, female of *Papilio hectorides*, Campinas, Sao Paulo; **b**, female from the *P. ascanius* colony in Parque Santa Dalila, RJ; **c**, female *Papilio torquatus polybius* from Campinas, SP; **d**, female from the *P. ascanius* colony in Barra de Sao Joao, RJ; **e**, *Imara pallasia*, ventral, Paineiras, RJ (700m), flies frequently in lowlands with *P. ascanius* but does not imitate its flight; **f**, *Graphium lysithous harrisianus*, Tijuca, Rio de Janeiro (near former Andarai colony of *P. ascanius*, see Fig. 3), Dec. 6, 1907. Last two in the Museu de Zoologia, Universidade de Sao Paulo. Scale under insects = cm.

In habitats where *P. ascanius* is common, several other presumably palatable Lepidoptera mimic it, but these cases seem to be "pulling away" from mimicry of the increasingly rare *P. ascanius* today. Thus, females of both *Papilio hectorides* Esper (Fig. 10a) and *P. torquatus polybius* Swainson (Fig. 10c), normally excellent mimics of *Parides agavus* (Drury) and female *Parides anchises nephalion* (Godart), respectively, often show excessive white and red markings in the Rio de Janeiro coastal plains (Figs. 10b, 10d), thereby strongly resembling *P. ascanius* under field conditions; but many members of the lowland populations do not show this tendency. The Castniid moth *Castnia Imara pallasia* (Eschscholtz) (Fig. 10c) also converges strikingly to the *P. ascanius* pattern, especially on the underside; but unlike *Castnia Imara garbei* (Foetterle) which mimics microsympatric *P.b. bunichus* excellently in both underside color and flight behavior in central Sao Paulo, *C. pallasia* flies high and rapidly, without excessive wing lifting, and only under exceptional circumstances could it be mistaken for *P. ascanius* in nature; it also occurs widely outside coastal swamps, even on hilltops.

By far the best mimic of *P. ascanius* in color-pattern and behavior is *Graphium lysithous harrisianus* Swainson, especially the usual form *platydesma* (Rothschild & Jordan) (Fig. 10f). Formerly very common in or near many *ascanius* habitats (D'Almeida, 1966:278), *harrisianus* has been seen since 1930 only on higher ground in more dense forest, and may today be confined to a single colony discovered in 1977 after over thirty years of no records at all. A single female captured in this colony in the "off season" (April 1982) showed appreciable evidence of genetic degeneration and low fecundity; this unusual subspecies of *Graphium* may be soon extinct.

This last known colony of the mimic was studied by mark-recapture methods in October 1984, when it was strong. As many as 150 adults were present, and females were as common as males, laying eggs on two species of Annonaceae (*Xylopia* and *Rollinia*). The adults flew rapidly through disturbed woods on non-floodable ground, visiting a variety of flowers and preferring habitats of mixed large blocks of deep shade and bright sun. This habitat used to be dominant in Rio de Janeiro sub-coastal forest but is now almost gone; it is usually adjacent to the swamps inhabited by *ascanius*. The majority of the population (60%) was of the *ascanius*-mimetic morph (*platydesma*, Fig. 10f), but *ascanius* has not been seen recently in the region, since its habitat is now destroyed there. Most of the rest (30%) was morph *oedippus*, an excellent mimic of the still abundant local *Parides anchises nephalion* and *P. zacynthus*. Selection in the future should transform this last known population completely to the latter form, unless *ascanius* can be re-introduced to the area or *G. lysithous* found in other places still flying beside *ascanius*. A more complete paper on the biology and ecology of *harrisianus* is in preparation.

Conservation of *P. ascanius*

The recently established (1974) Federal Biological Reserve of Poco das Antas, northeast of Rio de Janeiro (Fig. 3), is a large (5000-ha) and fairly well preserved (about 50% natural or regenerated vegetation) area which includes at present at least 1000 ha of ideal inland-wooded-swamp *P. ascanius* habitat, in several semicontinuous pieces. As the area is presently undergoing reorganization of flooded parts, under a river control program, this habitat is in an uncertain state of flux, but will probably expand in the coming years; the water level should be stabilized over large areas, creating new swamps, and in other places former swamps will be recovered. *P. ascanius* has been seen, in April 1982, in three widely separated areas of this Reserve; two of these were regarded as adequate colonies in typical habitat. This represents the most encouraging fact in the picture of *ascanius* conservation, but in view of the river works

and the still preliminary infrastructure of the Reserve (whose primary objective is to protect the Golden Lion Marmoset), it cannot be assigned full and exclusive responsibility in preservation of *ascanius.*

A small but apparently permanent colony of *P. ascanius* exists in a swampy forest less than two ha (five acres) in area, in the Parque Reserva Marapendi, Restinga de Jacarepagua in Rio de Janeiro (Fig. 3). As females are almost always present in this limited patch of forest (surrounded by open fields, houses, dry-land scrubby restinga and a uniform plantation of *Eugenia),* it may be presumed that the foodplant is present; however, only a few small plants of *A. macroura* have been found, all in the dryer restinga several hundred meters east of the colony. A little over a km west of this preserved patch is a large *macroura* stand in a heavily flooded swamp, supporting a very healthy population of *P. ascanius;* however, this area has been subdivided and will soon be drained and cleared. Whether the small preserved colony of *ascanius* will persist when its presumed founding source is destroyed is unpredictable. A large number of *macroura* plants were introduced into the best part of the Reserva colony on several different occasions; each time, all were destroyed by larvae of *Battus polydamas* (L.) and *B. crassus* (Cr.), which are very common in that area but very rare in the nearby large but condemned colony. We do not regard this Reserva colony as adequate in size, habitat, or stability to carry the weight for conservation of *P. ascanius,* but it should help to make the species observable and photographable for a time in the immediate area of Rio (topotypical) — especially if two key parts of the nearby but subdivided swamp colony may be protected from draining and building.

The coastal area northeast of Macae (Fig. 3) is mostly dry, cactus-dominated restinga, but *P. ascanius* has been seen there regularly and may reproduce in selected subcoastal swamps near the Lagoa Carapebus. This whole region (about 2 x 25 km) is being proposed as a "restinga" reserve by FEEMA (the Rio de Janeiro environmental agency), and may contribute to *ascanius* conservation if established in the future.

All other known coastal localities where *P. ascanius* still persists are either already drained and being developed, or under heavy pressure at the present, and we do not expect the species to survive in the "restinga" habitat unless the proposed Macae reserve is quickly assured and can be shown to contain permanent colonies of this species.

Should *P. ascanius* occur anywhere in the subtropical humid restingas or lowland swamps of coastal Sao Paulo (which we doubt; see above), it may be expected to be present and would be conserved in the Jureia Ecological Station (Fig. 3), which includes large areas of both types of habitat, in virgin state.

The main hope for *P. ascanius* perhaps lies in the little-explored and difficulty penetratable interior swamps of lowland Rio de Janeiro, which represent at least 1000 km^2 of still primitive and largely inaccessible habitat between Itaguai to the southwest and Campos to the northeast. To the extent that these swamps are unpleasant, mosquito-infested, difficult to enter or drain, and of marginal agricultural and negligible recreational value, many should escape "development" and hopefully continue to harbor colonies of *P. ascanius* in the foreseeable future.

Because of the highly restrictive ecological requirements and scattered distribution of *P. ascanius,* all in a limited part of one small Brazilian state, it should continue to be classified as "vulnerable" on official lists of animals threatened with extinction. Commerce in wild-caught specimens should be strictly prohibited (and punished by law, as well as discouraged by public and scientific opinion), captive breeding or official "farming" in its habitat encouraged, larval and adult resources enriched in partly developed areas (both thrive in disturbed humid lowlands), and populations in reserves carefully monitored, to guarantee its continued presence in the fauna of coastal Rio de Janeiro.

Tropical Butterfly Conservation and Mild Habitat Disturbance

It is well known by tropical lepidopterists that the highest diversity and abundance of forest butterflies can be found in moderately disturbed natural habitats such as treefalls, small clearings, trails, forest edges, and hilltops (Brown, 1972). Butterfly resources — especially fresh foodplant growth for larvae, and flowers for adults — tend to abound in these "liberated", partly sunny and complex systems. Many tropical forest butterflies, in the absence of the regular disturbances created in temperate zones by drastically seasonal climates, depend on these disturbed localities (or in the long run the continually changing canopy) to maintain adequate population levels. The multiplication of microhabitats with mild disturbance also permits a closer "packing" of similar species (even leading to substitution of ecological equivalents along a transect), and increases the probability of permanence for the poorest competitors and the most fragile populations in each guild (Gilbert, 1977; Brown, 1978).

It is tempting to suggest that mild and unpredictable habitat disturbance is a necessity for the management and maintenance of endangered tropical forest butterfly species (and other insects as well); it is certainly useful in monitoring, since it brings the species down from the canopy. The disturbance cannot be too strong, however, for it will then promote the excessively large populations of a few "weedy" species, or herbivores on weedy plants, which really do not need any special conservation measures. For example, a 10-ha portion of the 240-ha Campinas Forest Reserve which burned in the very dry winter of 1981 (August), was teeming with flowers and butterflies in the fall (April) of 1982; but the total species diversity was very low, consisting largely of garden species mixed with others whose larvae feed on the abundant vines which were initiating forest succession in the portion which burned (such as *Dynamine* on *Dalechampia* (Euphorbiaceae), *Biblis* on *Tragia* (Euphorbiaceae), Troidini on *Aristolochia, Dione moneta* Hbn. on *Passiflora warmingii* Mast.; Cucurbitaceae, Convolvulaceae, and Bignoniaceae vines also showed abundant insect herbivores). On sunlit roads and trails crossing unburned parts of the forest, as well as along flower-decked edges of these areas, total butterfly abundance was somewhat less than that of the burned portion but diversity was far greater, including species feeding on the full range of primary forest and secondary-succession plants.

Some especially significant data has emerged from recent studies in Amazonian habitats, especially in the "Minimum Critical Size of Ecosystems" project (WWF/INPA) north of Manaus (Brown, 1984). In these dense, dark forests, only a few well-adapted groups (especially Satyrinae and Ithomiinae) are regularly seen on trails; even deep-forest Riodininae prefer light gaps, and sun-loving Nymphalinae, Charaxinae, and Theclinae must be sought along open edges. Only the brightest habitats show Pieridae, Papilionidae, or Hesperiidae, many of whose species are nonetheless intimately tied into deep humid forest plants; one must conclude that their usual habitat is the canopy. Highest diversity is always observed by the ground-restricted naturalist in clearings, on brushy edges or ecotones, or in steep ravines subject to treefalls. Mild human disturbance (roads, edges, clearings) results in a great increase (usually over 100%) of species observed; in more drastically disturbed areas (old burns, pastures), a lesser number of species multiply excessively on favored second-growth plants and sometimes re-invade neighboring forests, competing strongly with self-regulated resident populations for food and even space. The total number of species seen in a day is usually under 30 in dense forest undergrowth, over 50 if small clearings, firebreaks, or other types of regrown and strongly illuminated disturbance are present, and near 100 if the system is more complex or more productive, with extensive light penetration to ground level and possibilities for varied plant

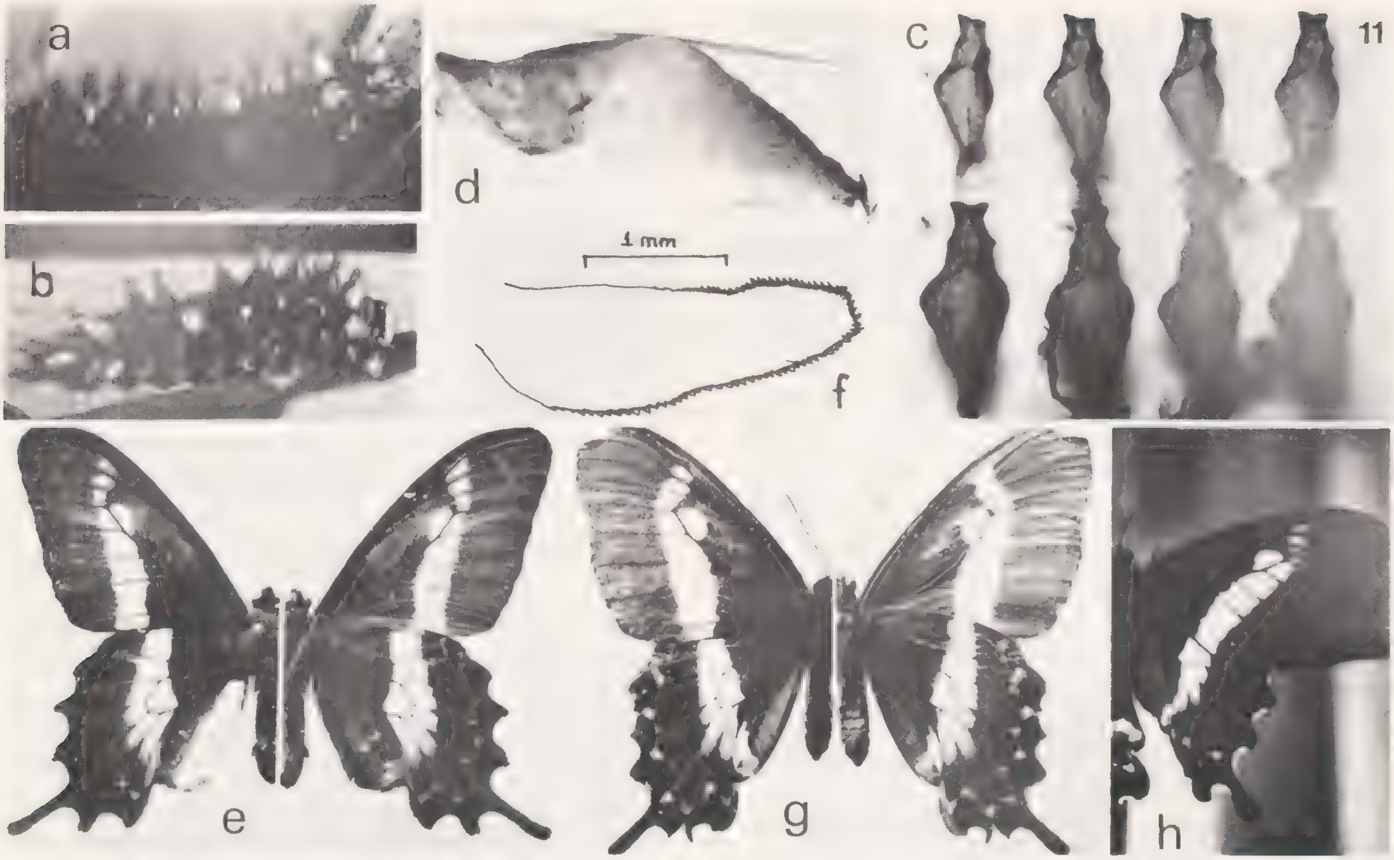

Figure 11. Hybridization *P. ascanius* x *P. bunichus*, 1982. **a,** first instar larva; **b,** third instar larva; **c,** eight pupae; **d,** male pupa (dorsolateral) showing diffuse dark red spots on first abdominal segment; **e,** adult male, dorsal (left) and ventral (right); **f,** harpe of right male valve; **g,** adult female, dorsal (left) and ventral; **h,** same female, alive shortly after emergence, perched on a leaf of *A. macroura*.

response. In more rolling topography and on rich soils (as in Mato Grosso, Rondonia, and southern Para), where disturbance is created by unpredictable dry seasons or cold spells, daily lists can average over 200 and reach 450 species (Brown, 1972, 1976, 1984).

It may be too much to expect for management plans for tropical forest reserves to specify occasional and local use of fire, flood, or felling to maintain diversity of understory plants and phytophagous invertebrates, even when some of these species may be on the list of those to be managed and preserved. The suggestion of Gilbert (1977, 1980) to permit shifting cultivation in "buffer zones" around tropical forest reserves, thereby continuously maintaining all stages of secondary succession nearby, may be a good compromise for the conservation of diversity. At least, the border of a forest reserve should not be a sharp green vertical wall overlooking concrete or asphalt, and some internal clearing should be encouraged, maintained, and not "cleaned-up" of second-growth plants, to permit their plant and animal species to continue to contribute to the over-all genetic heritage of the conservation unit. Certainly, all important forest species to be preserved should be studied carefully to determine the response of their populations in nature to different regimes of habitat disturbances. For further information on these ideas, see Gilbert (1980).

With relation to *P. ascanius,* its swampy habitats suffer a large degree of natural disturbance due to wind, salt spray, varying water levels, and poor soils; they also have a low irregular canopy and much sun at ground (water) level, promoting growth of flowers and *Aristolochia macroura.* Nevertheless, the largest colonies observed have always been in areas subject to additional human disturbance, often at the transitional point before final destruction, where *A. macroura* biomass multiplies rapidly and weedy Verbenaceae and Compositae thrive on edges. It is sure that *P. ascanius* could be preserved in planned suburban or exurban systems which included abundant garden flowers, planted *A. macroura* along fences, and carefully maintained patches of wooded swamp. The problem will inevitably rest in the latter, which represent unpleasant neighbors, breeders of mosquitoes, invariably to be drained whenever possible. If the over-all habitat is made too open, *Battus* will take over and probably eliminate *P. ascanius* from its foodplants. Whether *P. ascanius* and *Homo sapiens* will be able to coexist is still a debatable question, and in any conflict, the latter species is likely to predominate — even though the butterfly has the mosquitoes on its side in discouraging human occupation of its habitat, both will probably disappear with draining, as has happened consistently in the Rio de Janeiro area in the past (Fig. 3). The mosquitoes have returned, breeding in vast numbers in small receptacles which catch rainwater, but the elements of the *ascanius* system have not been able to colonize the concrete jungle.

Acknowledgements

We thank Dr. Sergio Fragoso for preparing the negatives for Figs. 1 (left), 4a, 6 (center), 7a-c, i, and k, and 8a-d, and J.Y. Miller for the slide which was transformed to Fig. 4e; other photographs are by the second author. Dra. Maria Teresa Jorge Padua, Director of the DN—IBDF, gave permission to work in the Reserva Biologica Poco das Antas, and provided a copy of the Management Plan for this reserve; the local administrator, Romildo Berto Mouro, was most helpful in our work there. The Minimum Critical Size of Ecosystems Project (WWF/INPA)

provided opportunities for work north of Manaus. Drs. Curtis J. Callaghan, Juvenal Laranja, and Heinz Ebert provided information on localities; Hamilton Tyler and David Hancock called our attention to the ICZN Opinion on *P. ascanius;* the Departamento de Botanica of the Museu Nacional, Rio de Janeiro gave much useful information on "restinga" plants; Dr. U.Y. Martins permitted photography of specimens in the Museu de Zoologia, USP — Sao Paulo (Figs. 10e, f); Dr. Ivan Sazima (Campinas) and Prof. Olaf H.H. Mielke (Curitiba) offered helpful suggestions on the manuscript. Norma C. Maciel Raimundo P.B. Henriques, and Dorothy Araujo of FEEMA (Rio de Janeiro) accompanied the authors in the projected "restinga" reserve north of Macae, and Anisio Fares provided transportation and information in the regions of Praia Grande and Mongagua (Sao Paulo). The Directorate of the Parque Reserva Marapendi kindly permitted field work and experiments to be undertaken in that area. Profa. Isolda Rocha e Silva, head of the Departamento de Entomologia of the Museu Nacional (Rio), greatly stimulated and facilitated field work of the first author. Pathogens and parasites of *P. ascanius* were identified by Prof. Carlos Fernando S. Andrade of the Departamento de Zoologia, UNICAMP. To all of these friends we extend our warm thanks for their collaboration in this project.

Note added in November 1982:

In June-October 1982, a successful hybridization experiment was performed with *P. ascanius* and *P. bunichus;* the results indicate a rather large genetic distance between these species, as suggested by the numerous differences in juvenile and adult morphology as well as ecological preferences.

An egg of *P. ascanius,* collected on *A. macroura* in Surui (see Fig. 3) on April 4 hatched on April 9; the larva was reared on *A. macroura* and pupated in Campinas on May 5. An adult female emerged on June 6. Various attempts to hand-pair her with *P. bunichus* males captured in Campinas on June 6-8 were unsuccessful. On the morning of June 10, "locking" was obtained with a large male *P. bunichus,* after the abdomen tips were held together at 90° angle for 2 min. The male began "pumping" 15 min. later, and abdomincal contractions of both members continued irregularly over one hour; 15 min. after they ceased, the pair separated. On the following day, the female laid 3 eggs on *A. macroura.* Further eggs were obtained on this plant or on the plastic bag in which the female was confined on June 14 (1), 15 (16), and 16 (8), for a total of 28; the female was attacked and destroyed by ants on June 17.

The eggs showed 16 vertical ridges and an average diameter of 1.57 mm (N = 22; intermediate in size between the extremes of the ranges of eggs of the two parental species, see Table 2). Twenty-two of the 28 eggs hatched between June 23 and 26, with an average duration on 10.5 days for the stage (range 7-13; 80% 10-12, unusually long, see Table 2). Eighteen larvae completed the first instar (Fig. 11a) on *A. macroura,* reaching an average length of 6.7 mm (longer than those of either parent) with average duration 5.3 days to successful molt (range 4-7). Fifteen mature second instar larvae averaged 10.4 mm long (also larger than either parent species) and those followed (10) spent an average of 6.0 days (range 5-7) in the stage. Measurements on two near-mature 3rd instar larvae (at 4 days) (Fig. 11b) averaged 14.6 mm; corresponding data for 4th and 5th instars were not obtained. Since disease was appearing in larvae under individual observation in dishes, the ten remaining 3rd instars were placed on large stems of living plants in Rio de Janeiro. Under these conditions, eight pupae were obtained in late July (average total larval stage about 30 days). The mature (fifth instar) larvae were intermediate in coloration between those of the parent species (Figs. 7k,m): darker than *ascanius,* with deeper yellow tubercles and a narrower side stripe.

The eight pupae (four of each sex) are shown in Fig. 11c. They varied in color from tan to greenish-yellow, not only tan like in *ascanius* nor fully green like some *bunichus.* Abdominal flanges were intermediate between the two parental species' conditions (Fig. 7p-r, t) as were two diffuse deep red dorsolateral spots on the first abdominal segment (see Fig. 11d). The male pupae measured 28.6 x 13.5 mm and weighed about 0.90 g after two weeks. The female pupae measured 32.9 x 16.8 mm and weighed about 1.75 g after two weeks. Under Rio de Janeiro conditions (cool and quite humid) no male pupae entered diapause; all gave viable adults after 20-25 days. All four female pupae entered diapause (weight loss less than 5 mg/day); the three kept in Campinas broke this state after about 40 days (losing more than 10 mg per day) and emerged nearly 50 days after pupation, while the female pupa in Rio went an additional 60 days (total near 110) before emergence. Three of the four females experienced difficulty in emergence from the pupal shell and wing expansion.

The adult males (Fig. 11e) refused to mate with *P. bunichus* females and showed a minute testicle; the genital organs (especially the penis) were partly atrophied and seemed to be nonfunctional, though the harpe (Fig. 11f) was normal and intermediate between those of the parental species. The adult females (Fig. 11g, 11h) emerged long after all males died, and showed a similarly atrophied reproductive system with no obviously functional vagina. They refused all mating advances of a number of active males of *P. bunichus* and *P. ascanius,* and locking could not be obtained even under forcing conditions of hand-pairing.

The adult color-pattern showed both blending of parental characters (as the white bands and rose infusion) and partial cancellation (very weak hourglass-shaped spots on the hindwing), suggesting a lack of coadapted gene complexes in this cross, possible even with non-homologous though similar characters.

All the results of this cross give strong evidence that it should be considered as interspecific.

In late 1982, 67 *ascanius* eggs were placed on a vigorous *A. melastoma* plant in Amarais, Campinas (where *bunichus* is abundant). A few small larvae were seen feeding there a week later, but no large larvae or adults were observed in the following months. In March 1983, however, a female specimen almost identical to the experimental Fls (Fig. 11) was captured in Amarais, indicating possibility of larval survivorship and natural hybridization. The female laid eggs (though they were infertile), suggesting that accidental introgression might be possible on occasion between *bunichus* and *ascanius,* should they come to be sympatric in disturbed landscapes in the future.

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TABLE I

SOME MORPHOCLIMATIC DOMAINS OF SOUTHERN AND SOUTHWESTERN SOUTH AMERICA (AB'SABER, 1977) WITH PRESENCE OF *P. ASCANIUS* AND ALLIES,[1] AND OTHER *PARIDES* SPECIES[2]

DOMAINS (from SE to NW)	*CLIMATE*	*VEGETATION*	*SOILS*	PARIDES *PRESENT*	*HABITAT*
Temperate pampas and fields (S Brazil, N Argentina, Uruguay)	Mediterranean, cool	Field and scrub	Brunizems (Prairie soils)	None; only two species in the more primitive genus *Euryades*	Open field and scrub, plateaus and mountains
Temperate forests (S Brazil, N Argentina)	Mediterranean, cool	Low riparian forests	Alluvial (River soils)	*P. bunichus damocrates*[1]	Forest edges and interior, scrub
Subtropical *Araucaria* woods (S Brazil planalto)	Perhumid, cool	Mixed broadleaf and conifers	Humic latosols (Swamps, peat)	*P. bunichus perrhebus*[1] *P. agavus* *P. anchises stilbon/ nephalion*	Forest edges, scrub Forest interior Deep humid forest
Chaco (Paraguay, N Argentina)	Dry, warm	Scrub and gallery woods	Poor latosols, Planosols	*P. agavus* *P. anchises nephalion/ foetterlei*	Humid gallery woods Dryer riparian thickets
Tropical semideciduous forests (S-C Brazil)	Seasonal, warm	Open seasonal forests	Rich "Terra Roxa" (paleosoil), Podzolized, Latosols	*P. bunichus bunichus*[1] *P. proneus*[1] *P. agavus* *P. anchises nephalion*	Forest edges, scrub Forest subedge, interior Humid forest interior Humid and dry thickets
Tropical rain forest (SE Brazil mountains)	Humid, warm	Dense forests with epiphytes	Podzolized soils and Cambisols	*P. proneus* *P. agavus* *P. tros* *P. anchises nephalion*	High-elevation woods Humid forest interior Superhumid forests Riparian habitats, local
Tropical "restinga" and lowland forests (SE Brazil coastal plains)	Dry to humid, hot, windy	Dunes, lagoons, Scrub with cacti, swamps, forests	Sandy, organic, Podzolized, Latosols	*P. ascanius*[1] *P. anchises nephalion* *P. zacynthus zacynthus*	Swampy thickets Humid forests, thickets Humid forests
Cerrado domain (central Brazil plateau)	Seasonal; hot and humid in summer	Scrub, gallery woods, headwater forests, marsh	Poor latosols, Alluvial clay	 *P. burchellanus* + *P. panthonus numa* *P. anchises foetterlei* *P. neophilus eurybates*	Scrub, edges, field Dense riverbank forest Dryer gallery woods Humid gallery woods
Transition forests (W-C Brazil to Bolivia, Peru)	Seasonal, hot, humid	Open forests and complex mixtures	"Terra roxa", Podzolized	Many species of *Parides* but no allies of *P. ascanius*	Mostly in riparian habitats
Upper Amazonian rain forests (Andean foothills, Peru)	Perhumid, hot or warm	Dense and open rain forests	Latosols, Podz., Cambisols	Many species of *Parides* but no allies *of P. ascanius*	Local in more rolling or riparian habitats
Upper Maranon and Santiago slopes above 1500 m (Ecuador)	Cool, not seasonal	Scrub and cloud forests	Lithosols (Rocky soils)	*P. phalaecus*[1] *P. erithalion lacydes/ chinchipensis*	Thickets, edges, scrub Cloud forests, streams

[1]See Figs. 2 and 4 for illustrations and distributions of allies of *P. ascanius.*

[2]*Battus* species, which can be strong foodplant competitors, are often present in more open habitats (Rausher, 1979).

TABLE 2

BIOMETRY OF EARLY STAGES OF *PARIDES ASCANIUS* (1976 and 1981-2 DATA), IN COMPARISON WITH *P. B. BUNICHUS*

DIMENSIONS

Diameter (to 0.01 mm)

STAGE	*P. ascanius* Mean	(N)	range (100%)	*P. bunichus*[2] Mean	(N)	range (100%)
EGG	1.73	(139)	1.60-1.92	1.32	(89)	1.19-1.44

LARVA	Total length when mature (0.1 mm): *P. ascanius* This work Mean (N)	*P. ascanius* This work range	*P. ascanius* D'Almeida[3] Mean (N=2)	*P. bunichus* This work Mean (N)	Head capsule width (0.01 mm): *P. ascanius* Mean (N)	*P. ascanius* range	*P. ascanius* 95%	*P. bunichus*[2] Mean (N)
1st instar	6.3 (26)	5.2-7.5	3.0	4.9 (25)	0.89 (44)	0.82 0.97	0.83 0.94	0.79 (165)
2nd instar	10.3 (26)	8.5-12.0	7.5	7.8 (4)	1.35 (39)	1.10 1.70	1.1 1.6	1.21 (75)
3rd instar	17.6 (21)	15.0-19.0	13.5	14.7 (13)	2.08 (30)	1.80 2.48	1.9 2.4	1.6 (17)
4th instar	26.7 (14)	23.0-31.0	20	23.2 (25)	3.18 (33)	2.50 3.76	2.7 3.6	2.6 (31)
5th instar	46.5 (14)	40.0-51.0	45	36.8 (23)	4.67 (34)	4.09 5.20	4.4 5.2	3.8 (14)

tubercles: mean 2.45 vs 1.8 mm

DURATION (in days)[1]

STAGE	*P. ascanius* This work Mean (N)	*P. ascanius* This work Range	*P. ascanius* This work 95%	D'Almeida (1922)[3] Mean (N)	*P. bunichus* This work[4] Mean (N)
EGG	8.0 (171)	5-11	7-9	10 (3)	7.0 (55)
1st instar	5.0 (72)	3-9	4-6	7 (2)	3.8 (70)
2nd instar	4.7 (56)	3-7	4-6	6.5(2)	3.2 (64)
3rd instar	4.7 (44)	3-7	3-6	5.5(2)	3.4 (60)
4th instar	6.8 (28)	5-13	5-9	10.5(2)	4.5 (54)
5th instar	8.5 (14)	7-12	7-12	23.5(2)	5.9 (37)
Prepupa	2.0 (13)	2	2		2.0 (11)
TOTAL LARVAL DEVELOPMENT TIME[1]	31.7 (13)	27-39	27-35	53 (2)	22.8 (11)
PUPA	18.6 (5)	17-20	-	27 (2)	17.8 (5)
TOTAL JUVENILE DEVELOPMENT TIME[1]	59.4 (5)	53-67	-	86.5(2)	46.8 (5)

PUPA (in mm)	*P. ascanius* Mean (N=9)	*P. ascanius* range	D'Almeida[3]	*P. bunichus* (N=7) Mean
Total length	35	33-37	26	27.9
Total width	15	14-16.5	-	12.7
Total depth	10	10-10.5	-	-

[1]Campinas summer temperatures, average 23°C, similar to Rio de Janeiro winter temperatures; Rio de Janeiro summer temperatures are about 2°C warmer on the average, giving durations about 20% less for all stages.
[2]Data from Brown, Damman and Feeny (1981).
[3]Larvae on a relatively unsuitable foodplant (presumably *A. rumicifolia* var. *oblonga*); see D'Almeida (1922, 1966).
[4]Statistically identical development was observed on *A. melastoma*, *A. arcuata*, and *A. macroura*, the last unfamiliar to this species.

TABLE 3

FOODPLANT ACCEPTANCE BY *P. ASCANIUS* IN CAPTIVITY[1]

Aristolochia species tested (more advanced →)

EXPERIMENT	*melastoma*	*odora*[2]	*arcuata*	*rumicifolia*[2]	*triangularis*	*macroura*[2]	*paulistana*[2?]	*esperanzae*	*cymbifera*[2]	*galeata*	*elegans*	*gigantea*
Female oviposition	−	(±)	−	−	−	+	NT	NT	(±)	NT	NT	NT
Larval feeding:												
first instar	±	NT	±	−	−	+	+0	−	−	−	NT	NT
later instars	−	NT	−	±	+0	+	+0	NT	−	NT	−	−

[1]+ = accepted well, +0 = accepted but gave high mortality, ± = limited acceptance, (±) = accidental use, − = rejected in all experiments, NT = not tested.

[2]Foodplant available to *P. ascanius* populations in nature.

The Ecology and Conservation of the Glow worm, *Lampyris noctiluca* (L.) in Britain

John Tyler
Sevenoaks Wildfowl Reserve, Tadorna, Bradbourne Vale Road,
Sevenoaks, Kent TN13 3DH, England

Introduction

It has all too often been the case in conservation that a species known to be declining has been allowed to do so unchecked, in the belief that its future can be adequately safeguarded by the protection of areas of apparently suitable habitat. It is not until the species is near the brink of extinction that such an approach is recognised to be insufficient, and detailed autecological research is deemed necessary, by which time the species is so scarce that the sampling of populations and the manipulation of habitat necessary to determine the reasons for the decline may simply precipitate the species' disappearance. In 1979 the large blue butterfly *Maculinea arion* (L.) became extinct in Britain, after a decline lasting at least a hundred years, but only in the final ten years was any serious form of ecological research undertaken to seek the underlying causes (Thomas, 1980).

The glow worm *Lampyris noctiluca* (L.) in Britain provides an excellent example of a species at an earlier stage of decline. As in the case of the large blue this cannot be accounted for solely in terms of habitat destruction but, unlike the large blue, populations are still sufficiently large to provide material for ecological study. This article is an attempt to bring together existing information on the ecology and status of *L. noctiluca* in order to provide a starting point for the thorough research which will be needed if its disappearance in Britain is to be avoided.

Life history

Despite its misleading common name of 'glow worm' *Lampyris noctiluca* is in reality a beetle, and one of just two British representatives of the Family Lampyridae (the other, *Phosphaenus hemipterus* (Gz.), being confined in Britain to the New Forest area).

The adult glow worm exhibits a marked sexual dimorphism, the male (Fig. 1, middle), having a fairly typical coleopteran form, whilst the female (Fig. 1, left) is larviform and flightless, with neither wings nor elytra.

Each female produces approximately a hundred eggs (Balduf, 1935), depositing them either singly or in clusters on grass stems and the underside of leaves. They are about 1mm in diameter, a pale luminous yellow, and hatch within four to six weeks into larvae approximately 5mm in length.

The larvae (Fig. 1, right) are commonly found under flat stones, among rotting vegetation and in rubbish heaps (Brendell, pers. comm.) and will live for up to three years, during which time they undergo five moults (Vogel, 1927). Although often seen in strong sunlight they are predominantly nocturnal and feed almost exclusively on snails. It is not clear whether the prey are located by means of their mucus trails (Wootton, 1971) or simply by chance (Balduf, 1935), but once encountered the snail is injected with a fluid from the larva's hollow mandibles which both paralyses and digests it so that the liquified body contents can then be sucked out of the shell, a screen of inwardly pointing hairs across the mouth of the larva preventing ingestion of solid particles (Haddon, 1915). In this way a larva weighing 55mg is capable of overpowering a snail more than two hundred times its own body weight (Vogel, 1915). Feeding in this way is a relatively lengthy procedure, not uncommonly taking 12 hours or more to complete. There appears to be a preference for flat or globular rather than spire-shaped snails: species eaten in captivity include *Arion* sp., *Succinea* sp., *Helix hortensis* (Muller), *Arianta arbustorum* (L.), *Helicella itala* (L.) (Vogel, 1915), *Helix aspersa* (Muller), *Hygromia striolata* (Pfeiffer) and *Oxychilus* sp. (Wootton, 1976), and larvae have also been seen eating the slug *Deroceras reticulatum* (Muller) (Ellis, pers. comm.). O'Donald (1968) has recorded larvae feeding on *Helix nemoralis* (L.) in the wild, and indeed has found evidence that this predation may in some cases be so intense as to exert considerable selection pressure upon genes controlling shell pattern. Communal feeding has been observed in captivity (Wootton, 1971). Feeding is sporadic and larvae may go several days without food.

The pupal period is relatively short, lasting eight days in females and eleven in males (Vogel, 1927).

Although it is possible to find adult glow worms in Britain at almost any time between June and August, any one individual is unlikely to survive longer than two weeks. As with many other invertebrate species there appears to be a correlation between latitude and the time of adult emergence, populations in the north tending to emerge later than those in the south. The female *L. noctiluca* are generally the first to appear, males usually following a few days later.

Light produced by the reaction between luciferase and luciferin is emitted from the terminal three segments of the female's abdomen to attract airborne males. The duration of the display on any particular night is heavily dependent on the prevailing weather conditions: a cool evening will restrict it to one or two hours whilst heavy rain may prevent it entirely, and since males rely totally on the light to locate females, bad weather during the critical period of adult maturity can have serious consequences for reproductive success.

Although relatively bright (under favourable conditions it is visible to the human eye at a distance of 50m or more) the light does not appear to deter such predators as frogs, toads, newts and hedgehogs (Brendell, pers. comm.).

Adult males die soon after mating and females shortly after oviposition.

Habitat requirements

Feeding almost exclusively on snails, the distribution of the glow worm tends to reflect the habitat requirements of its prey, statistical analysis (Tyler, 1979) revealing a significant correlation between the British distribution of *L. noctiluca* and the species density of molluscs. It is a predominantly grassland insect, again consistent with a species feeding on snails, and although found on almost every soil type in Britain is particularly abundant on calcareous soils, which provide the calcium necessary for shell

Figure 1. Glow worm, *Lampyris noctiluca*: female (top), male (middle) and larva (bottom).

growth in snails. Of 255 sightings recorded by members of the British Naturalists' Association (British Naturalists' Association, 1971, 1972, 1974, 1977), 58% were made in grassland habitats of one sort or another. Even when recorded in woodland they are usually confined to grassy paths and clearings.

Wet ground is also a common feature of glow worm sites and they are often to be found in fens and wet meadow, as well as at the margins of ponds, lakes and canals. Other suitable habitats include moorland, roadside verges and railway lines (both used and disused).

Status

Figure 2 shows a preliminary map of the world distribution of *L. noctiluca,* compiled simply by shading those countries in which the species is known to occur. Although somewhat inaccurate in detail it does show the glow worm to be a remarkably widespread species, and indicates that unless the decline noted in Britain is mirrored elsewhere (a possibility which cannot be disregarded) the disappearance of the British population would not make a significant dent in the species' overall abundance: on a global scale the glow worm seems relatively secure, at least for the time being.

Quantitative data on the relative abundance of *L. noctiluca* in recent years is understandably scarce: accurate recording of population changes over a period of years is difficult at the best of times, and particularly so for a nocturnal species which is only readily detected for little more than two weeks of the year. Nevertheless the somewhat anecdotal information available does point to three tentative conclusions:

Firstly, that the British population of *L. noctiluca* has undergone a considerable decrease over the past fifty years or so, and that this decline is still continuing today.

Secondly, that this decline is not confined to a particular region but rather has occurred over much of the species' British range.

And finally, that the decrease is not confined to any one habitat type. This conclusion is supported by observations from chalk grassland, fen, woodland and sand dune areas, in each of which glow worm numbers have been seen to fall in recent years.

Conservation.

As for the cause, or causes, of the decline there has certainly been no shortage of suggestions, but there *has* been an almost complete lack of research to substantiate any of them.

Although doubtless a contributory factor, habitat destruction does not appear to be the primary cause, for even on sites which have remained apparently unchanged for many years dramatic decreases, and in some cases total disappearance, of glow worm populations have been reported.

If it is indeed the case that the threat to *L. noctiluca* stems not from habitat destruction but from the more subtle effects of some form of habitat degradation, then the acquisition of nature reserves containing superficially suitable habitat is unlikely to prove effective and the underlying ecological causes of the decline must be sought and tackled if the glow worm is to remain in the British fauna. In particular the following factors seem to merit further attention:

a) Pollution, from industrial emissions in urban areas and agricultural chemicals in the countryside, may well be partly to blame. As a predator the glow worm would be particularly vulnerable to the accumulation of toxins, received in sub-lethal doses from the snails upon which it feeds.

b) Long-term climatic changes such as shifts in rainfall or temperature, whether as part of a natural trend or as a result of atmospheric pollution, could also be expected to have serious consequences for a species in which reproduction is confined to approximately 1-2% of the individual's lifespan. Abnormally high rainfall or low temperatures during this critical period would inhibit the female's display and thus reduce the frequency of successful matings.

c) Habitat fragmentation. Seemingly random and often violent fluctuations in population density are commonplace in natural communities and may often lead to the local disappearance of a species during unfavourable years. In the natural situation these would rapidly be made good by recolonisation from adjacent populations, but in the increasingly fragmented patchwork of the British landscape, where urban and agricultural development have led to extreme isolation of the surviving pockets of natural habitat, this balance of extinction and recolonisation is disrupted, and a species being lost from a site may take many years to re-establish itself. Three features of the glow worm's ecology make it a prime target for the effects of habitat fragmentation. Firstly being a predator, and one with relatively specialised feeding requirements, it tends to be limited to lower population densities than for example a generalised herbivore of the same size. Secondly, as already noted, its reproductive success is heavily dependent on suitable weather conditions during a critical phase of its life cycle. The combination of these two factors makes *L. noctiluca* particularly prone to large fluctuations in population density and local extinction (for example counts made on a site in Buckinghamshire between 1979 and 1982 range from 5 to 200 females). The third factor is the glow worm's extremely poor powers of dispersal. Although the males are strong flyers the colonising range of the species is limited by the mobility of the wingless female larva (the adult females are extremely sedentary and seldom travel more than a metre from one night to the next). This makes the re-establishment of local populations a very slow and hazardous operation, since a small stream or even a fairly busy road may prove a serious obstacle to a pedestrian larva.

d) Changes in grazing pressure. In lowland Britain the grassland on which *L. noctiluca* is so dependent is an essentially man-made habitat produced by the clearance of forest, and without some form of intervention would tend to revert through scrub to woodland. This succession is (or was) held in check largely by the grazing of herbivores, particularly the rabbit *Oryctolagus cuniculus* (L.), in some cases supplemented by burning or mechanical cutting. However, during the 1950's the introduction of myxomatosis into Britain severely reduced the rabbit population, and with it the intensity of grazing on open grassland. This has in turn

Figure 2. Approximate Eurasian distribution of *Lampyris noctiluca* (L.).

allowed scrub to encroach on formerly open areas, with profound effects on their plant and animal communities. This reduction in cropping intensity has in many parts of the country been further compounded by a decline in the number of sheep grazed on unimproved pasture. Casualties of the shift in grassland composition include butterflies such as the large blue, already mentioned above, and a number of orchid species, and it may be that *L. noctiluca* too is unable to tolerate the new habitat conditions.

Other factors, such as the deflection of males by house lights in heavily populated areas and the drainage of fens and wet meadows particularly prevalent in the low-lying regions of East Anglia, cannot be ignored but their effects are unlikely to be more than local, and their contribution to the overall decline small.

Some work is already being carried out to evaluate the importance of various possible causes, and to develop means of overcoming them. A long-term project has been established on a reserve managed by the Berkshire, Buckinghamshire and Oxon Naturalists' Trust, where glow worm populations will be recorded on mown, sheep-grazed and control plots in order to assess the importance of cropping intensity, whilst a preliminary study on experimental plots at Aston Rowant National Nature Reserve suggest that if sheep-grazing is to be used as a management tool in maintaining open grassland the intensity must be carefully controlled, too much being as harmful as too little. In addition a survey has been launched to determine more accurately the range of *L. noctiluca* in Europe and Asia and to look for any evidence of changes in abundance of the sort seen in Britain.

This is however just a minute fraction of the research which will be necessary if the glow worm, together with countless other species in the same position, are to be conserved.

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Prairie and Plains Disclimax and Disappearing Butterflies in the Central United States

Kurt Johnson[1]

Department of Entomology
American Museum of Natural History
Central Park West at 79th Street, New York
New York 10024

Abstract

A survey of historical change in the prairie-plains flora of the central United States is presented, along with assessment of corresponding changes in the associated butterfly fauna. Emphasis is placed on the process of disclimax, or catastrophic disruption of successional processes in a plant community reliant on succession. Broad correlations exist between various patterns of disclimax and the documentable loss of native prairie-plains butterfly taxa.

Introduction

A significant number of publications on the butterfly faunas of the plains and prairie regions of the Central United States appeared during the period 1960-1980 (Christenson, 1971; Downey Irwin, 1974; Ferris, 1971; Johnson, 1972 [1973]; McCabe and Post, 1977; Miller, 1972; Puckering and Post, 1960; Field, dos Passos, and Masters, 1974, list many other studies from these areas). All of these regional faunal studies suggested that significant changes in butterfly species diversity and community composition were occurring within the region.

Many of these authors in fact mentioned disappearing butterfly taxa and briefly documented outstanding examples in their study areas. In these instances, destruction of vegetation characteristic of certain ecological associations was implicated as a significant factor in the disappearance. In this paper I assemble a broad range of data on the nature of ecological alteration in the flora of the central United States during the past century. I then attempt to correlate these data to the documentable cases of ongoing butterfly population loss within the central United States. The paper thus constitutes an historically valuable record of apparent changes in butterfly faunas and their associated ecological causes, and serves as a baseline study for ongoing research in the central United States.

Format of the Data Base Tables

The data in this paper have been organized into three "Data Base Tables:" I, Larval Foodplants Affected by Particular Disclimax Conditions; II, Cross References of Conditions in Table I to Particular Butterfly Taxa; and III, Documentable Butterfly Population Losses per Ecological Community. Collectively, the Data Base Tables document the last recorded captures of particular butterfly taxa in a six-state area of the central United States, and correlate larval foodplant records for these butterflies with botanical literature relative to disclimax. To facilitate rapid retrieval of information, index numbers cross-referenced to topics of discussion in the text have been used along the left margins of the Data Base Tables (see Table 1). Interested readers should focus in particular on the use of Data Base Tables I and II for the butterfly communities in their own areas, with Data Base Table III serving to summarize available knowledge about changes in particular plant communities over much broader geographic areas.

Latin usages in this paper conform to dos Passos (1964) for butterflies, and Gleason (1952) and Shetler and Skog (1978) for plants. Larval foodplant data come from Tietz (1972), as amended by the following literature: Brower, 1958; Brown et al., 1957; Burns, 1964; Chambers, 1963; Christenson, 1971; Downey and Dunn, 1965; Ehrlich and Ehrlich, 1961; Emmel, 1964, 1969; Emmel and Emmel, 1962, 1964; Ferris, 1971; Gorelick, 1969; Heitzman, 1965, 1966; Johnson, 1972 (1973); Kendall, 1964, 1966; Klots, 1951; the Lepidopterists' Society News, years 1966-1972; MacNeill, 1964; Neck, 1973; Riotte, 1968; Scott et al., 1968; Shapiro, 1965, 1968, 1970).

The Study Area

The "Great Plains" and "Central Lowlands" comprise the vast area of plains and prairie extending eastward from the Rocky Mountains to the western margin of the great deciduous forest (Minnesota south to Texas). The Great Plains is characterized by its native climax of mid- and short grasses, intermixed in respective upper and lower layers. The Great Plains range eastward to an indistinct juncture with the Central Lowlands, areas once covered by true or tall-grass prairie. The juncture is usually characterized by the line of 20 inch annual rainfall, 1500 foot elevation, and/or the 97th Meridian (Weaver 1954; Weaver and Albertson, 1956).

The true or tall-grass prairie is partitioned by water relations (Weaver and Himmel, 1931) into low moisture "upland" and high moisture "lowland" areas. Uplands are characterized by the dominant Little Bluestem (*Andropogon scoparius*) community (with its secondary *Bouteloua curtipendula and Koeleria cristata*), and the minor Needlegrass (*Stipa spartea*) and Prairie Dropseed (*Scorobolus heterolepis*) communities. Lowlands are characterized by the Big Bluestem (*Andropogon furcatus*) community (with secondary *Sorghastrum nutans*) and the minor Sloughgrass (*Spartina pectinata*) and Switchgrass (*Panicum virgatum*) — Canada Wild-Rye (*Elymus canadensis*) communities.

Upland and lowland true prairie are interspersed according to local conditions, and largely replaced westward by the mixed prairie of mid-grasses (e.g., Western Wheatgrass, *Agropyron smithii*) and short grasses (e.g., Blue Grama, *Bouteloua oracilis*, Hairy Grama, *B. hirsuta*, and Buffalo Grass, *Buchloe dactyloides*). These mid- and short grasses are uncommon on the true prairie,

[1]Research Associate, University of Wisconsin Museum of Natural History

but become dominant in South Dakota and northeastern Wyoming (as *Stipa-Agropyron-Buchloe*) and western Nebraska, Kansas, eastern Colorado and southern Wyoming (as Bouteloua). The fully short-grass prairie, a disclimax community, exhibits such indicators of deterioration as cacti (*Opuntia*), sage brushes (*Artemisia*), and Broom Snakeweed (*Gutierrezia sarothrae*).

Characteristics of Disclimax

The process of disclimax refers to the catastrophic disruption of successional processes in a plant community reliant on succession (Weaver, 1954). A knowledge of the natural dynamics of the prairie and plains communities is important for understanding prairie-plains disclimax.

First, although true prairie gradually gave way to mixed prairie as one went from east to west across the central United States, the plants indicative of each prairie type were all extant in any one locality. The east-west replacement was thus quantitative, not qualitative, and the same force (available water) that governed the broad geographic replacement was also responsible for governing distributions of prairie types in local areas. Second, the native vegetational communities comprising true prairie, mixed prairie, and the short-grass disclimax prairie (*sensu* Weaver) were all closed communities, successionally quite dependent upon each other in both time and space (Shimak, 1911; Weaver, 1954; Weaver and Albertson, 1956).

By nature, the dominant plains-prairie plants and perennial climax grasses were adapted to the normal disruptive influences of range fire, drought, intense native grazing, and interspecific competition (Stewart, 1936) — and this admixture of the several prairie types in all localities insured eventual recovery through the processes of recolonization and succession. However, human disruption of these plant communities did not have the same effects as did the natural disruptive forces: subdivision of the native prairie restricted the capacity for recolonization; agricultural practices perturbed local water relations (and hence the characteristic vegetational admixtures and their successional patterns), opening the door for disclimax. While the nature of the disruption during the last century is only incompletely documented, the record is clearer for the first half of this century — the native environment had largely disappeared by the great droughts of the 1930s and 1940s (Bowles, 1971; McArdle, 1936; Sampson, 1921; Weaver, 1954; Weaver and Albertson, 1956; Weaver and Himmel, 1936; the work by Weaver and his colleagues is exemplary in illustrating the nature of disclimax on both micro- and macroenvironmental scales).

Corresponding Alterations in the Butterfly Fauna

Whether due to unwise land use, drought, over-grazing, clearing, "development," or other causes, disclimax conditions promote the survival of only particular plant taxa, and therefore have profound effects upon native lepidopteran faunas. Among the above causes, drought and over-grazing both favor upland (low moisture) vegetation, since they decrease protective cover. Conversely, breaks in the topography (e.g., gullies, water margins, and ditches), with the associated variety of slopes and exposures, often provide refugia for relict populations of lowland (high moisture) grasses and forbs.

Data Base Table I presents the effects of various disclimax conditions on prairie-plains plants serving as lepidopteran larval foodplants. Data Base Table II provides cross references of these conditions to the particular butterfly taxa. Much insight concerning butterfly losses on a large geographic scale can be acquired by scrutinizing these Data Base Tables, but it is more difficult to predict the effects of disclimax on particular local butterfly populations. While it is important to examine the general trends, one must of course be realistic about the limitations for local inferences. It is assumed that local lepidopterists will find changes in butterfly diversity and numbers in their area explained to some degree by these broad correlations.

An important caveat to bear in mind when reading the Data Base Tables is collecting bias (in the broad sense). For example, very early and late flight seasons may imply poorer sampling of species on the wing at such times (e.g., *Carterocephalus palaemon* and *Hesperia leonardus*). Other butterflies are frequently misidentified in the field due to confusion with related congeners (e.g., *Phyciodes, Colias*) or unrelated but similar species (e.g., *Amblyscirtes oslari* with *Euphyes vestris, Hemiargus isola* with *Everes comyntas*). Still others may be overlooked because of secretive habits or seldom collected habitats (e.g., *Calephilis muticum, Nastra lherminier, Megathymids*).

Butterflies who gain during disclimax are those feeding on plants affected positively by the environmental change, and vice versa. In the vegetation, disclimax first affects the dominants (in the case of prairies and plains these are the top-tier grasses), spreads to the lower-tier grasses, and finally to the associated forbs (Clements, 1945; Weaver, 1954; Weaver and Albertson, 1956). Logically, particular top-tier grass feeding butterflies disappear first, followed by the corresponding lower-tier grass and forb feeding taxa. At the same time, gains are made by butterflies using replacer grasses, domestics, early invaders, and weedy annuals as larval foods. Concomitantly, vegetation along margins becomes more important in providing adequate plant diversity to maintain butterflies feeding on woody plants and/or native prairie plants. In turn, this tends to concentrate available larval substrates, and the less ecologically plastic species may be lost through increased competition. Typical of relict patches of vegetation — large or small — is that they cannot provide the full supportive effect of the original environment (Heitzman, 1965; Hovanitz, 1963; Livingston, 1948; Morgan, 1963).

Disclimax thus greatly favors species such as *Pieris rapae, Colias philodice, C. eurytheme, Euptoieta claudia,* and *Everes comyntas,* which utilize domestics or a diversity of indigenous plants as larval foods, and which can easily out-compete butterflies tied to particular indigenous plants. Disclimax also favors *Phyciodes, Chlosyne, Vanessa, Pyrgus, Strymon melinus, Lycaena thoe* and *L. helloides* because their larval foodplants are successful during disclimax. Hesperiidae and Satyridae adaptable to domestic grasses (*Polites mystic, Amblyscirtes vialis, Cercyonis pegala*) or grasses serving as lower-tier replacers (*Hesperia uncus, H. viridis, H. pahaska, Polites mystic, Poanes taxiles, Atalopedes campestris*) also gain, as do butterflies using agriculturally important plants (*Callophrys siva, C. eryphon, Colias philodice, C. eurytheme, Lycaeides melissa, Lerodea eufala, Polygonia interragationis*).

Lost during disclimax are the species with more fragile ecological niches: the top-tier feeders (e.g., *Hesperia ottoe, H. pawnee, H. metea, H. dacotae, Neominois ridingsii*), those sensitive to the composition of the native environment itself (*Speyeria idalia, Pieris napi, Problema byssus, Atrytone aragos, Melitaea pola*), and probably weaker competitors among concentrated congeners (*Speyeria atlantis, S. zerene, S. callippe*). Insects feeding on low prairie plants generally become more common than those on high prairie plants, since breaks in topography corner runoff (favoring survival of low prairie plants) and deplete the high prairie of water; high prairie is also more accessible to man and machinery.

Each plant community becomes transformed uniquely by disclimax. Data Base Table III summarizes these transformations, including the important original community characteristics, the relevant disturbance factors, and the evidence for gains and losses of particular butterfly taxa. Data Base Table III devotes particular attention to three major botanical associations (Tall-Grass Prairie, Mixed-Grass Prairie, Short-Grass Disclimax Prairie) and three major natural refugia (Marsh and Water Margins, Montane Escarpment, Interspersed Eastern Deciduous Forest).

A scan of Data Base Table III indicates that butterfly-

foodplant associations having undergone the most intensive local population extinctions are those characterising the native prairie climax communities, and those with a sharp woodland association characterized formerly by montane butterfly taxa. Wetlands and other marginal environmental associations show some apparent losses or gains, but these cannot be deemed as historically significant as the changes in entire sectors of the climax biota (the wetland declines are mostly due to very localized draining and limitation of natural margins by technology). Similarly, while the massive decline of the prairie and plains climax communities can be linked directly to interference by man (catastrophic disclimax having occurred within a period of 50-60 years), loss of the montane escarpment has also been ongoing naturally during recent geological time. As Johnson (1975) has pointed out, the decline of the former western Great Plains conifer forests has been gradual throughout the most recent (post-Wisconsinan) interglacial period. East of the Rocky Mountain front range, *Pinus ponderosa* climax associations occur only in the Black Hills of South Dakota. These associations and pine-juniper savannah once prevailed over much of the western Great Plains, and have only recently (during the last 600 years) ceded ground to drought and fire (Wells, 1970a, 1970b; Johnson, 1975). Thus, the rapid loss of prairie butterflies through disclimax parallels the ongoing, slow loss of scarp woodland butterflies from processes acting over geological time.

Summary and Historical Perspective

An initial survey of the apparent relationship between destruction of native biota and the disappearance of butterflies in the central United States has been presented here. Despite the obviously imperfect available record of changes in prairie-plains Lepidoptera populations over time (notably the lack of detailed, long-term autecological studies), a large volume of useable data has been assembled from specimen records, trends noted in the literature, and personal contact with collectors. I hope that these data will constitute a valuable record of apparent changes in butterfly faunas and their associated ecological causes, and serve as a baseline for ongoing lepidopteran research in the central United States. In this regard, a historical perspective on the paper is necessary.

Much of the information for the Data Base Tables was first assembled during the early and mid 1970s. On the occasion of the Xerces Society's fifth anniversary in 1976, I was asked to prepare a study examining documentable changes in the butterfly faunas of the central United States. Since the Society's commemorative volume did not eventually appear, my original manuscript lay idle for several years. It was updated again in 1980, and the present paper is a condensed version of those earlier manuscripts.

The long hiatus has meant of course that some of the butterfly taxa documented here as "lost" have been variously "rediscovered." Ongoing sampling by Dr. John C. Downey in Iowa (a state book is reported as forthcoming; Downey, pers. comm.), Dr. Clifford D. Ferris and Richard Rosche in western Nebraska (see e.g., the Lepidopterist's News, 1983, Volume 5), and concerned workers in Colorado like Ray Stanford (Stanford, 1976, 1977) and Dr. James Scott (as in Scott et al., 1968) has done much to further monitoring efforts in these areas. It is significant that Rosche and Ferris (pers. comm.) report extant populations in these states of some butterfly "indicators" of the native prairie-plains, scarp woodland and relict deciduous forest plant communities.

Sadly, the famous forest-prairie relict region in Monroe Canyon, western Nebraska (Sioux County), where important early Lepidoptera expeditions were conducted (Barber, 1894; Cary, 1901; Leussler, 1913, 1938, 1939), has since fallen victim to a new highway. I returned to the canyon in 1981, and was unable to locate any of the bottomland meadows where I collected native plains-prairie plants and butterflies during the 1970s (Johnson, 1972. (1973) voucher material is in the American Museum of Natural History). Recent light trapping at the now heavily filled and graded campground yielded a moth catch of some 90 percent domestic pests (E. Quinter, pers. comm.).

The actual location of the other famous 19th century collecting locality — "Warbonnet Canyon" *sensu* Barber, Cary, and Leussler (op. cit.) — has not yet been established with certainty, but seems at least to be an area not presently accessible by road. I visited "Lone Tree Canyon" in Goshen County, eastern Wyoming, in 1973, and found an isolated but richly vegetated wet bottomland in which taxa like *Lycaena rubidus, Mitoura siva,* montane *Speyeria,* and others flew in sympatry with deciduous forst relict indicator species (e.g., *Asterocampa celtis antonia, Nymphalis vau-album j-album, Colias* [*Zerene*] *cesonia*). These latter species are rare or unknown in Wyoming (C. D. Ferris, pers. comm. and 1971).

Acknowledgements

The original suggestions for this research were made by Dr. John C. Downey (Univ. Northern Iowa). I am most grateful to him and Michael Christensen (Mitchell, S. Dakota) for access to the compiled records of butterflies of Illinois and Iowa, and for many hours of useful discussion. I also thank J. R. Heitzman, Robert M. Pyle, Larry J. Orsak, and Lawrence F. Gall for reading preliminary drafts and making editorial suggestions. The curators at the following institutions graciously provided access to specimens and records from their collections: Southern Illinois University, Ohio State University, Iowa State University, Illinois Natural History Survey, Chadron State College, Kearney State College, Grinnell College, Upper Iowa University, University of Northern Iowa, University of Nebraska. Special thanks regarding specimen data and records are due to Frederick H. Rindge (American Museum of Natural History), William D. Field (United States National Museum), and F. Martin Brown (Colorado Springs, Colorado).

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Table 1. Numbered keys to Data Base Tables

DATA BASE TABLE I: Lepidopteran Larval Foodplants Affected by Disclimax

1. True prairie climax dominants
2. Foodplants GAINING during disclimax from true to mixed prairie
3. Foodplants LOSING during disclimax from true to mixed prairie
4. Foodplants GAINING during disclimax from mixed to short-grass prairie
5. Foodplants LOSING during disclimax from mixed to short-grass prairie
6. Foodplants positively influenced by drought
7. Foodplants negatively influenced by drought
8. Foodplants positively influenced by grazing
9. Foodplants negatively influenced by grazing
10. Foodplants affected by mowing
11. Foodplants increasing on bare, overused, abandoned or wasted areas
12. Foodplants with special vulnerabilities
13. Foodplants affiliated with particular refugia:
    13. general scrub areas and their margins
    14. oak and dogwood thickets and their margins
    15. sumac thickets and their margins
    16. oak forests and their margins
    17. maple forests and their margins
    18. water margins
    19. floodplains
    20. blowouts
    21. badlands
    22. prairie lakes
23. Foodplants provided as domestics by man

DATA BASE TABLE II: Cross Reference From DBT-I to Particular Butterfly Taxa

1. Butterflies feeding on genera of plants in Data Base Table I
   (sources provided in text, under Format of the Data Base Tables)
2. Key to plant families in Data Base Table II

DATA BASE TABLE III: Documented Butterfly Losses from Specific Communities

1. Tall-grass prairie
    1. present conditions
    2. disturbance factors
    3. butterfly losses and declines
    4. butterfly survivors in refugia: prairie reserves
    5. butterfly survivors in refugia: prairie relicts
    6. butterfly survivors in refugia: planted areas
7. Mixed-grass prairie
    7. present conditions
    8. disturbance factors
    9. butterfly losses and declines
    10. butterfly survivors in refugia: prairie reserves
    11. butterfly survivors in refugia: prairie relicts
    12. influence of particular refugium factors
13. Short-grass disclimax prairie: references
14. Marsh and water margin refugia
    14. present conditions
    15. disturbance factors
    16. butterfly losses and declines
    17. butterfly survivors in refugia: marshes
    18. butterfly survivors in refugia: moist margins
    19. butterfly survivors in refugia: wet woodlands
20. Montane Escarpment refugia
    20. present conditions
    21. disturbance factors
    22. butterfly losses and declines
    23. butterfly survivors in refugia: margins
    24. butterfly survivors in refugia: deciduous river bottoms
    25. influence of particular refugium factors
26. Eastern Deciduous Forest refugia
    26. present conditions
    27. disturbance factors
    28. butterfly losses and declines
    29. butterfly survivors in refugia
    30. influence of particular refugium factors

DATA BASE: TABLE I.

TABLE I. LARVAL FOODPLANTS AFFECTED BY PARTICULAR DISCLIMAX CONDITIONS[4]

1 Foodplants which are true prairie climax dominants (Weaver, 1954; Weaver and Albertson, 1956):
2 Upland-- Andropogon scoparius; Lowland-- Andropogon furcatus. Foodplants positively affected by
disclimax from true prairie to mixed prairie (Weaver, 1954; Weaver and Albertson, 1956): Ar-
temisia sp., Astragalus sp., Opuntia sp. [H (see below)], Oxytropis sp., Sphaeralcea sp. Food
3 plants negatively affected by same (see above): Baptisia sp., Baptisia tintoria. Foodplants
4 positively affected by dislimax from mixed prairie to short-grass prairie: Astragalus sp.,
Chenopodium sp., Erigeron sp., Festuca sp., Opuntia sp. [H], Plantago sp. (see also sections on
5 drought, overgrazing, wasted ground, dominant forbs of short-grass disclimax.) Foodplants nega-
tively affected by same (see above): all taxa listed above save Opuntia. Foodplants positively
6 affected by drought (Weaver, 1954; Weaver and Albertson, 1956; Weaver and Himmel, 1931): Aster
sp., Astragalus sp., Bouteloua sp., Cirsium sp., Plantago sp., Sphaeralcea sp. Foodplants nega-
7 tively affected by same (see above): Ambrosia sp., Andropogon sp., Antennaria sp., Cynodon sp.,
Erigeron sp., Pentstemon sp., Stipa sp., all Leguminosae, Umbelliferae. Foodplants positively
8 affected by grazing (McArdle, 1936; Weaver, 1954; Weaver and Albertson, 1956; Weaver and Clements,
1938): Achillea sp., Ambrosia sp., Artemisia sp., Asclepias sp., Aster sp., Bouteloua sp.,
Bromus sp., Cirsium sp., Helianthus sp., Opuntia sp.[H], Poa pratensis, Solanum sp., Solidago sp.,
9 Sphaeralcea sp. Foodplants negatively affected by same (see above): All climax prairie dominants,
Allium sp., Amorpha sp., Astragalus sp., Lomantium sp.,Lupinus sp., Pentstemon sp., Petalastemon
sp., Rosa sp., Vicia sp., all Leguminosae. Foodplants characteristic of complete overgrazing
(Weaver and Albertson, 1956): Chenopodium sp., Lepidium sp., Plantago sp., Polygonum sp., So-
10 lanum sp. Foodplants affected by mowing (Hopkins, 1941; Weaver, 1954; Weaver and Albertson, 19-
56): Annual Mowing-- favors recurrence of characteristics of true prairie, corresponding in na-
ture to prairie fires or native grazing. Invasion of Poa pratensis, however, can reverse this
effect: little spring ground cover favors the true prairie plants, but spring cover of Poa or
dead cover of annuals from previous year prevents their early growth. Hopkins (1941) reports an-
nual mowing caused an admixture of 1/3 each, true, mixed and short-grass prairie. Regular Mowing
-- very negative to all native growth, destroying native perenials at mid-growth. This opposes
their recurrence by causing excessive ground cover, or inroads for Poa pratensis or weedy annuals.
11 Foodplants positively affected by bare, overused, abandoned, or wasted ground (including early in-
vaders)(Pool, 1914; Tolstead, 1942; Weaver, 1954; Weaver and Albertson, 1956; Weaver and Himmel,
1931): Amaranthus sp., Artemisia sp., Chenopodium sp., Cirsium sp., Helianthus sp., Lepidium sp.,
Panicum sp., Plantago sp., Polygonum sp., Portulaca sp., Solidago sp., Climax prairie dominants in
12 spring. Foodplants with special vulnerabilities (Weaver and Albertson, 1956): Early spring spe-
cies-- Antennaria sp., Lomantium sp.; Recovery or re-establishment difficult-- Ambrosia sp., An-
tennaria sp.; Lose foodhold as others recover-- Sphaeralcea sp. Foodplants affected by particular
13 refugia conditions-- [General scrub areas and their margins, thrive here (hereafter t.h.)(Weaver,
1965; Weaver and Thiel, 1917): Amphicarpa sp., Corylus sp., Poa pratensis, Rhus sp., Viburnum sp.
14 Oak and Dogwood thickets and their margins, t. h. (Weaver, 1965; Weaver and Thiel, 1917): Amphi-
15 carpa sp., Cornus sp., Desmodium sp., Vicia sp., Quercus sp. Sumac thickets and their margins,
t. h. (Weaver and Thiel, 1917): Cardanus sp., Polygonum sp., Prunus sp., Ribes sp., Rhus sp., Rosa
16 sp. Oak forests and their margins, t. h. (Weaver, 1965; Weaver and Thiel, 1917): Populus sp.,
17 Prunus sp., Quercus sp., (see Quercus margins, above). Maple forests and their margins, t. h.
18 (Weaver and Thiel, 1917): Carya sp., Ribes sp., Viola sp. Water margins, t. h.(Morgan, 1963;Tolstead,
1942; Weaver, 1954; Weaver, 1960; Weaver and Albertson, 1956): Amorpha fruticosa, Betula nigra
(upland streams, extreme west plains only), Celtis sp., Humulus sp., Polygonum (drywashes and
gravelled areas only), Populus sp.(upland streams, west plains), Rhus sp., Salix sp., Ulmus sp.,
19 Urtica sp.(dry washes and bare ground only), mesic Apiaceae, Poaceae.; floodplains (Weaver, 1960)--
20 Acer sp., Celtis sp., Fraxinus sp., Juglans sp., Ulmus sp. Blowouts, t. h. (Pool, 1914): Artemisia
sp., Asclepias sp., Erigeron sp., Eriogonum sp., Euphorbia sp., Lathyrus sp., Pentstemon sp. Bad-
21 lands, t. h. (Weaver and Albertson, 1956): Artemisia sp. Asclepias sp., Aster sp., Opuntia sp.[H]
22 Sphaeralcea sp. Bare ground, t. h. (see above-- bare, overused, abandoned etc.). Plains lakes, t.
h. (Pool, 1914; Tolstead, 1941, 1942): Post-climax true prairie (frequency of true prairie climax
species and other dominants, but not full admixture)-- Andropogon sp., Rudbeckia sp., Tridens sp.,
Asclepias sp., Rumex sp., Viola sp., various Fabaceae.] Foodplants provided as domestics planted
23 by man-- [Aristolochia sp., Althaea sp., Bromus sp., Celtis sp., Fraxinus sp., Juniperus sp., Medi-
cago sp., Petunia sp., Pinus sp., Poa pratensis, Rosa sp., Spiraea sp., Tilia sp., Trifolium sp.,
Vaccinium sp., Viola sp. Footnote-- [H] indicates plant is a disclimax indicator.

[4] including larval foodplants characteristic of resulting margins and refugia.

DATA BASE: TABLE II.

TABLE II. CROSS REFERENCES OF CONDITIONS IN TABLE I TO PARTICULAR BUTTERFLY TAXA[5]

1 Achillea sp. (At [=keyed plant family, see below]): Pyrgus communis. Althaea sp. (M): P. communis; Vanessa caryae. Amaranthus sp. (A): Erynnis martialis; Pholisora catullus; Staphylus hayhurstii. Ambrosia sp. (At): P. catullus. Amorpha fruticosa (F): Colias caesonia. Amphicarpa sp. (F): Eurema lisa. Andropogon furctatus (P): Atrytone arogos, delaware; Hesperiidae; Satyridae. Andropogon scoparius (P): Atrytonopsis hiana; Hesperia metea, ottoe. Antennaria sp. (At): Vanessa virginiensis. Apiaceae: Papilio polyxenes, zelicaon. Aquilegia sp. (R): Erynnis lucilius. Aristolochia s . (Ar): Battus philenor. Artemisia sp. (At): Vanessa cardui, virginiensis; Cercyonis meadii [H]. Asclepias sp. (As): Celastrina argiolus; Danaus gillipus, plexippus. Aster sp. (As): Chlosyne gorgone, harrisii, nycteis; Phyciodes batesii, picta, tharos. Astragalus sp. (F): Colias alexandra, eurytheme, philodice; Eurema mexicana; Glaucopsyche lygdamus; Lycaeides melissa; Plebejus acmon, Panthaides m-album, Thorybes bathyllus. Baptisia sp. (F): Achalarus lyciades; E. martialis, baptaisae, zarruco. Baptisia tintoria (F): Everes comyntas, Incisalia irus. Betula sp. (B): Limenitis arthemis; Nymphalis vau-album; Papilio glaucus; Polygonia faunus, hylas. Bromus sp. (P): Hesperiidae, Satyridae. Bouteloua sp. (P): Hesperia uncas, viridis; Neominois ridingsii; Hesperiidae, Satyridae. Cardanus sp. (At): V. cardui. Carya sp. (J): Satyrium caryaevorus, falacer. Celtis sp. (U): Asterocampa celtis, clyton; Polygonia interrogationis. Chenopodium sp. (Ch): Lycaena helloides; P. catullus; S. hayhurstii. Cirsium sp. (At): V. cardui. Cornus sp. (Co): C. argiolus. Corylus sp. (B): Erynnis juvenalis. Cynodon sp. (P): Atalopedes campestris; Hesperiidae; Satyridae. Desmodium sp. (F): A. lyciades; Epargyreus clarus; Everes amyntula, comyntas; T. bathyllus, pylades. Erigeron sp. (At): Pieris protodice. Eriogonum sp. (Py): P. acmon. Fabaceae: T. pylades. Festuca sp., (P): Hesperiidae; Satyridae. Fraxinus sp. (O): Euphydryas phaeton; Feniseca tarquinius; P. glaucus, multicaudatus. Galium sp. (Ru): L. helloides. Helianthus sp. (At): C. gorgone, lacinia, nycteis; V. cardui. Humulus sp. (U): Polygonia comma, interrogationis; Strymon melinus; Vanessa atalanta. Juglans sp. (J): S. falacer. Lathyrus sp. (F): E. juvenalis; E. comyntas; G. lygdamus. Lepidium sp. (Br): P. protodice. Lomantium sp. (Am): Papilio indra, zelicaon. Lupinus sp. (F): C. alexandra; E. lucilius; G. lygdamus; Plebejus icarioides; Scolitantides piasus; S. melinus; Vanessa caryae. Medicago sp. (F): C. alexandra, eurytheme, philodice; Lerodea eufala; L. melissa. Opuntia sp. (C): H. uncas [H]. Oxytropis sp. (F): C. alexandra. Panicum sp. (P): A. arogos, delaware; Polites themistocles; Wallengrenia otho; Hesperiidae, Satyridae. Pentstemon sp. (S): Euphydryas anicia, arachne. Petunia sp. (So): Brephidium exilis. Plantago sp. (Pl): Junonia coenia. Poa pratensis (P): Amblyscirtes vialis; Polites mystic; Hesperiidae; Satyridae. Polygonum sp. (Py): B. philenor; L. helloides, thoe; S. melinus. Populus sp. (Sa): Erynnis icelus, persius; L. arthemis, archippus; N. vau-album, antiopa; P. glaucus. Portulaca sp. (Pt): Euptoieta claudia. Prunus sp. (R): Harkenclenus titus; Incisalia henrici; Limenitis sp.; P. glaucus; Satyrium liparops; S. melinus. Quercus sp. (Fa): E. juvenalis, brizo; H. titus; Limenitis archippus; P. m-album; S. liparops, falacer, ontario; S. melinus. Quercus ilicifolia (Fa): E. brizo, juvenalis; L. arthemis astyanax; Satyrium edwardsii. Rhus sp. (An): C. argiolus. Ribes sp. (Sx): E. claudia; F. tarquinius; L. arthemis; N. antiopa; P. faunus, hylas, progne, zephyrus. Rosa sp. (Ro): N. antiopa; Rumex sp. (Py): C. argiolus; L. helloides, thoe, rubidus. Rumex hymenosepalus (Py): Lycaena xanthoides. Salix sp. (Sa): C. argiolus; E. icelus, persius; L. archippus, arthemis, weidemeyerii; N. antiopa, vau-album; S. liparops, acadica. Sedum sp. (Cr): Parnassius phoebus; E. claudia. Sphaeralcea sp. (M): P. communis; S. melinus. Spiraea sp. (Ro): C. argiolus. Stipa sp. (P): Hesperia pawnee; Hesperiidae, Satyridae. Tilia sp. (T): P. interrogationis. Trifolium sp. (F): C. argiolus; C. philodice; E. amyntula, comyntas; Plebejus saepiolus. Ulmus sp. (U): P. interrogationis, progne. Urtica sp. (U): N. antiopa, milberti; P. comma, interrogationis, satyrus; V. atalanta. Vaccinium sp. (Er): C. argiolus; I. henrici, augustinus; S. liparops. Viburnum sp. (C): C. argiolus; E. phaeton; F. tarquinius. Vicia sp. (F): C. eurytheme, philodice; E. amyntula; G. lygdamus; T. pylades.
2 Viola sp. (V): Boloria sp.; Speyeria sp. Yucca sp. (L): Megathymidae. KEY TO PLANT FAMILIES--(A) Amaranthaceae; (Am) Ammiaceae; (An) Anacardiaceae; (Ap) Apiaceae; (Ar) Aristolochiaceae; (As) Asclepiadaceae; (At) Asteraceae; (B) Betulaceae; (Br) Brassicaceae; (C) Cactaceae; (Ch) Chenopodiaceae; (Co) Cornaceae; (Cp) Caprifoliaceae; (Cr) Crassulaceae; (E) Ericaceae; (F) Fabaceae; (Fa) Fagaceae; (J) Juglanaceae; (L) Liliaceae; (M) Malvaceae; (O) Oleaceae; (P) Poaceae; (Pl) Plantaginaceae; (Pt) Portulaceae; (Py) Polygonaceae; (R) Ranunculaceae; (Ro) Rosaceae; (Ru) Rubiaceae; (S) Scrophulariaceae; (Sa) Salicaceae; (So) Solanaceae; (Sx) Saxifragaceae; (T) Tiliaceae; (U) Urticaceae; (V) Violaceae. [H] indicates butterfly is a disclimax indicator.

[5]Plant taxa correspond to Table I. They are listed in alphabetical order. In parentheses after each name is the abbreviation of the appropriate family keyed at the base of the table. Each plant taxon is followed by an alphabetical list of associated butterflies. After the initial use of the binomials, genus is abbreviated. More than one species per genus follow in series. Whole groups feeding on a plant taxon are listed as such (Hesperiidae, Satyrdae, Limenitis sp. etc.). Sources in text and bibliography.

DATA BASE: TABLE III.

TABLE III. DOCUMENTABLE BUTTERFLY POPULATION LOSSES PER ECOLOGICAL COMMUNITY[6,7]

1 TALL-GRASS PRAIRIE: Conditions. Now completely absent from plains and prairie areas of the United
States except for survival of scattered relicts (Shimek and Conrad, 1948; Weaver, 1954, 1965; Wea-
ver and Albertson, 1956; Weaver and Himmel, 1931), some not with full admixture or species diversity
(Livingston, 1948; Pool, 1914; Tolstead, 1941). Areas are either mixed-grass prairie or short-grass
2 disclimax. Disturbance Factors. Easy extinction through land use and drought, culminated in the
Great Droughts of the 1930's. Continuum needed for sustaining random structure of closed community
fractured, followed by intertwined effects of loss of the co-dominant grasses, other grasses having
3 been introduced by early east-west movements of man and livestock being irreplaceable. Butterfly
Losses and/or Declines. (l.r.= last recorded collection; o.r.= only recorded collection; m.= museum
record only source; p.c.=personal communication as source) Poanes massasoit (l.r. Iowa 1917, Lind-
say [1917]). Polites vibex (l.r. Iowa 1908, Porter [1908] & m.; not recorded Ill. [=Illinois], Nebr.
[=Nebraska]. Euphyes bimacula (l.r. Nebr. 1914, Leussler [1913; 38]. Hesperia metea (l.r. Iowa 1913,
1925,1926, Hendrickson [1928]; not recorded Ill., Nebr. Problemma byssus (o.r. Iowa 1962 m.; not re-
corded Ill. until 1942-63 [not on prairie,however]. Hesperia leonardus (l.r. Iowa 1869 Scudder [1869]
1914 Lindsay [1917], 1937 m., l.r. Ill. 1896 m. Hesperia sassacus (l.r. Iowa 1869 Scudder [1869],
1914 Lindsay [1917], 1937 m., l.r. Ill. 1896 m. Hesperia pawnee (l.r. Nebr. 1923 m., l.r. Colo. [=
Colorado] 1946 Brown, Eff & Rotger [1957]. Hesperia attalus (l.r. Nebr. 1913, 1922 Leussler [1913;38]
l.r. Iowa 1914 Lindsay [1917], not recorded Ill. Atrytone arogos (l.r. Nebr. 1939 Leussler [1939],
once 1965 Johnson [1972(1973)], l.r. Iowa 1936 m., again 1970 Christenson [1971], l.r. Ill. 1880
Worthington [1880], o.r. Colo. 1953 Brown,Eff & Rotger [1957]. Ochlodes sylvanoides (l.r. Iowa 1969
Scudder [1869]. Note: adaptation of P. massasoit and E. bimacula to low-prairie mesic plants pre-
4 serves some populations. Butterflies Surviving in Refugia. State Prairie Preserves, Iowa-- A. ar-
ogos, Polites origines, Oarisma poweshiek; Ill.-- H. leonardus, Erynnis zarucco, Poanes viator, P.
5 byssus [Christenson (1971),Downey & Irwin (1974),Shapiro 1970(1971)]. Unique Prairie Relicts, Black
Forest of Colo. [because of high water table] [Brown, Eff & Rotger (1957), Livingston (1948)]-- forb
6 feeding Incisalia. Domestically Planted Areas, entire region-- Polites themistocles, Poanes hobomok,
Polites coras (domestic grasses); Erynnis juvenalis (Quercus, Corylus margins); Polygonia interriga-
tionis (planted Ulmus); Asterocampa celtis (planted and water margin Celtis); Thorybes bathyllus (va-
7 rious Fabaceae). MIXED-GRASS PRAIRIE: Conditions. Much of original mixed-grass prairie now short
grass disclimax. Land use major cause, especially grazing. Most areas with predominance of discli-
max indicators or use of planted annuals to increase yearly grass cover. Scattered broken topography
8 and various margins provide refugia. Disturbance Factors. "Fracturing" of random continuum needed to
maintain closed community, caused by grazing, land use, wind, drought. Co-dominant grasses disappear
first, density of larval foodplants necessary for butterfly populations (Dethier [1954], Downey and
9 Fuller [1961] severely altercated. Butterfly Losses and/or Declines. Hesperia ottoe (l.r. Nebr. 1911
1923, 1924, 1925 Leussler [1913; 38], again 1949 R. Heitzman p.c., l.r. Iowa 1917, 1921 m., l.r. Colo
old undated [Brown, Eff & Rotger (1957)], l.r. Ill. 1963-64 Downey and Irwin [1964]. Neominois ridin-
gsii (l.r. Nebr. 1908 Leussler [1938], current Colo. Brown, Eff & Rotger [1957]. Hesperia pawnee (l.
r. Nebr. 1898, 1922 Leussler [1913;38], l.r. Iowa 1917 Lindsay [1917], not recorded Ill., l.r. Colo.
1905, 1946 Brown, Eff & Rotger [1957]. Hesperia colorado (l.r. Nebr. 1911, Leussler [1913;38], cur-
rent Colo., l.r. Iowa 1917 Lindsay [1917]. Melitaea pola (l.r. Nebr. 1921 Leussler [1938], current
Colo. Hesperia docotae (l.r. Ill. 1895 m., not recorded Nebr., Iowa, Colo., l.r. South Dakota 1894
m. Amblyscirtes samoset (l.r. Iowa 1914 Lindsay [1917], not recorded Nebr., not recently frequent
10 Ill. Downey & Irwin [1974]. Butterflies Surviving in Refugia. State Prairie Preserves, see previous
lists under tall-grass prairie as preserves includes relicts of each in Ill.,Iowa; no state prairies
11 Nebr., one National Grassland used for grazing; no state prairies, Colo. Unique Prairie Relicts,
Nebr.-- Lycaena rubidus on post-climax relicts, central Nebr. due to high water table; Black Forest,
Colo.-- H. pawnee, L. rubidus as above [Johnson and Nixon (1967), Johnson (1972[1973]),Brown, Eff &
Rotger (1957), Miller (1972)]; Hesperiidae occur in higher density/diversities westward because re-
placement of top-tier grasses by eastern secondaries is less possible [Weaver & Albertson (1956)].
12 Increasing or Decreasing Depending of Particular Refugia Factors-- H. ottoe, becoming established in
Ill. [Downey and Irwin (1974)]; disappearing in Iowa [Lindsay (1917)]; increasing in Nebr. where
Bouteloua is a replacer grass [Johnson (1972[1973])]. Atrytonopsis hiana, disappearing in Iowa [Ch-
ristenson (1971)]; rare in Illinois [Downey & Irwin (1974)]; increasing in Nebr. where trees in pine/
grassland savannah inhibit prairie destruction [Johnson, data (1971)]. Thorybes pylades, as in entry
under A. hiana. Atalopedes campestris, increasing in Iowa, Nebr. (not found Iowa before 1970)[Chris-
tenson (1971); Johnson & Nixon (1967); Johnson 1972[1973])] due to spread of Panicum, Cynodon spp.
Yvretta rhesus, increasing Nebr. since Bouteloua is replacer grass in short-grass disclimax [Leussler
(1938) compare Johnson & Nixon (1967), Johnson(1972 [1973])]. Cercyonis oetus, increasing western

TABLE III is continued...

TABLE III, Cont. . .

TABLE III. Continued...

Great Plains due to affinity to sagebrush habitat and its place in disclimax [see data in Brown, Eff
& Rotger (1957), Cary (1901), Emmel (1969), Johnson and Nixon (1967), Johnson (1972[1973]) and com-
pare Hayward (1928), Nixon (1967), and Weaver and Albertson (1956)]. L. rubidus increasing as noted,
previous entry, western Great Plains. Colias alexandra (increasing western Great Plains as Astraga-
lus is favored by disclimax [see data in Brown, Eff & Rotger (1957), Ferris (1971), Johnson and Ni-
xon (1967), Johnson 1972[1973]), Miller (1972), Puckering & Post (1960) and compare citations, above
entry]).Polites mystic (increasing everywhere as Poa pratensis becomes common invader of used land
and woodland floors [see data Johnson (1972[1973]), (data [1971]), Miller (1972) and compare cita-
tions, Table I., Annual, Regular Mowing, Post-climax true prairie, Scrub areas and their margins]).
13 SHORT-GRASS DISCLIMAX PRAIRIE: For conditions, establishment factors, and butterfly taxa becoming
established herein see body of paper, noting correlations from Table I. (disclimax conditions-- suc-
cession of original true and mixed- grass prairie co-dominants by replacers, domestics, also plants
of bare, used, abandoned, drought/grazing/mowing/-influenced ground and dominant forbs of short-
grass disclimax) with butterfly taxa of Table II. emphasized in the text. See also entries,Table III
14 called "Increasing or Decreasing Depending on Particular Refugia Factors". MARSH AND WATER MARGIN
15 REFUGIA: Conditions. Two aspects-- as original habitat or suitability as refugium. Disturbance
Factors. Unless lost by incorporation into urban area, landfill, or pollution, remains particularly
undisturbed due to relationship with broken topography and inaccessibility to machinery. Butterfly
16 Losses and /or Declines. Polites massasoit (l.r. Iowa 1917 m.) Euphyes bimacula (l.r. Nebr. 1913
Leussler [1913] locale now urbanized); surviving, but limited, state prairies Iowa [Christenson (19-
71)]. Lycaena epixanthe (l.r. Wisconsin 1902 m., l.r. Ill. 1897 French [1897]) probably due to dom-
17 estic manipulation of bogs, cranberry industry. Butterflies Surviving in Refugia. Marshes-- Erynnis
spp.,(common [Christenson (1971), Downey & Irwin (1974), Johnson (1972[1973]), Miller (1972)]). Po-
anes viator (rediscovered Ill. Downey & Irwin [1974]). Euphyes conspicua (locally common, Ill.
Downey & Irwin [1974]). Euphyes dion (still common, Iowa Christenson [1971]). Problemma byssus
18 (recently locally common Ill. Downey & Irwin [1974]). Moist Margins-- Staphylus hayhurstii, Ambly-
scirtes vialis, Axcyloxypha numitor (common [see citations, Erynnis spp. entry]). Atrytone logan
19 (still found Colo. Brown, Eff & Rotger [1957]). Wet Woodlands-- Carterocephalus palaemon (locally
common, Wisconsin, Johnson & Malick [1971]). Incisalia spp. (forb-feeding)(locally common Colo.
20 Brown, Eff & Rotger [1957], Miller [1972]). MONTANE ESCARPMENT REFUGIA: Conditions. On western
Great Plains montane environ limited to remaining climax relict Ponderosa Pine (Pinus ponderosa var.
scopulorum) forests and non-riparian woodlands: Black Hills (South Dakota)[climax], Pine Ridge (Ne-
br.)[non-riparian scarpland(nsw)], Cheyenne Ridge (Nebraska--Wildcat Hills, Wyoming-- Goshen Co.,
canyons)[nsw], Others (Nebraska-- Niobrara Escarpments, Wyoming-- Pine Bluffs,North Dakota-- Little
21 Missouri River Escarpments)[nsw]. Disturbance Factors. Road building, cultivation/grazing/mowing
of interspersed meadows, clearing and domestic "improvements", parks, diversion or pollution of wat-
er, timber management and thinning, planting of domestics, concentration of interspecific competi-
tion due to niche reduction. Butterfly Losses and/or Declines. Plebejus shasta minnehaha (l.r.
Nebr. 1901 Cary [1901], 1913 Leussler [1938]). Cercyonis meadii (l.r. Nebr. 1901 Cary [1901],
1921 Luessler [1938], once recent 1964 ver. Johnson [1972(1973)]). Neominois ridingsii (l.r. Nebr.
1933 Leussler m. ver. Johnson [1972(1973)]. Papilio indra (l.r. Nebr. 1900 m. ver Johnson [1972 (19-
72)], 1919 Leussler [1938]). Papilio rutulus (l.r. Nebr.1901 Cary [1901]). Papilio nitra (l.r. Nebr.
1919 Leussler [1938]). Speyeria atlantis (l.r. Nebr. 1901 Cary [1901], 1921 Leussler [1938]). Poly-
gonia satyrus (l.r. 1921 Leussler [1938]). Scolitantides piasus (l.r. Nebr. 1901 Cary [1901], again
once 1929 Leussler m., 1964 m.). Euchloe ausonides (l.r. Nebr. 1901 Cary [1901]). Neophasia menapia
(l.r. Nebr. 1929 Leussler m., again once 1965 Johnson and Nixon [1967]). Parnassius phoebus (l.r.
Nebr. 1911 Leussler m., again one [sight] ver. Johnson [1972(1973)]). Hesperia comma (l.r. Leussler
23 1911 m.). Butterflies Surviving in Refugia. Margins-S.callippe, S. zerene, Colias alexandra, Eup-
hydras anicia, Oeneis uhleri, Pieris sisymbrii, Plebejus icarioides, Polygonia zephyrus, Amblyscirtes
oslari (surviving in small numbers, undisturbed pine/prairie margins, deep canyons Pine Ridge, Nebr.
C. alexandra, S. callippe, Wildcat Hills, Nebr., C. alexandra locally more abundant Astragalus dis-
24 climax [recent records Johnson & Nixon (1967), Johnson (1972[1973])]. Deciduous River Bottoms--
Lethe eurydice, Nymphalis vau-album, Phyciodes batesii, Asterocampa celtis antonia, Polygonia progne,
Plebejus saepiolus, Glaucopsyche lygdamus (surviving in small numbers, Pine Ridge, Nebr. [recent
25 records Johnson & Nixon (1967), Johnson (1972,1973]). Increasing or Decreasing Depending on Particu-
lar Refugia Factors-- Cercyonis oetus (see entry, Mixed-grass prairie). C. alexandra (see entry,
this section). Incisalia eryphon, Mitoura siva (increasing western Great Plains cultivated Pinus,
Juniperus respectively.). Lycaena rubidus (see entry, Mixed-grass prairie). Polites mystic (see
entry, Mixed-grass prairie). For species increasing due to interspersed Short-grass disclimax see
26 entry under Short-grass disclimax prairie. INTERSPERSED EASTERN DECIDUOUS FOREST REFUGIA: Conditions

TABLE III is continued...

TABLE III, Cont. . .

TABLE III. Continued...

Three kinds-- northern forest with history of boreal influence, general plains woodlands, and south-
ern influenced forest of Missouri-Mississippi River basins. Three aspects-- as original habitat,
as general refugia on biome level, small woodlands providing margins. Iowa once covered heavily
with deciduous forest along its water courses, at least 85% of the state (Iowa State Planning Board
[1859] and shortly after completely extirpated to plains. Nebraska with less forest initially but
Missouri basin still providing some habitats (Weaver [1965]). Relicts in canyons, western Great
Plains from Wisconsinan-Cordilleran periods (Morgan [1963], Johnson [1975]). Southern-influenced
forests still in Illinois; northern influenced forest nearly gone in Iowa, Illinois (Shimek & Conrad
27 [1948], Downey & Irwin [1974]). Disturbance Factors. Cutting, destroying canopy/general floor vege-
28 tation; replacement by domestics and annuals on disturbed floor; limitation of undisturbed habitats
from movement of domestic animals or man. Butterfly Losses and/or Declines. Speyeria atlantis (l.
r. Iowa 1908 Porter [1908], l.r. Ill. 1939 m.). Pieris napi (l.r. Iowa 1889 Scudder m., l.r. Ill.
1887 French [1897], 1880 Thomas [1880], 1881 Middleton [1881]), suggested as related to canopy des-
truction (Hovanitz [1962]). Pyrgus centaurae (l.r. Ill. undated old specimen ver. curator m.).
Speyeria diana (l.r. Ill. 1869, 1890 m., again 1960 m., attributed to deforestation (Clark and Clark
29 [1951]). Butterflies Surviving in Refugia. Limenitis arthemis arthemis (rare northward Ill. Downey
& Irwin [1974], l.r. Iowa 1889 Scudder m., 1908 Porter [1908], 1914 Wolden [Christenson (1971)],
again once, sight Christenson [1971], l.r. Nebr. Gunder m. possibly erroneous). Nymphalis vau-album
(frequently recorded boreal Iowa, Ill. Christenson [1971], Downey & Irwin [1974], rare in relicts
western Nebr. Pine Ridge, recent records Johnson [1972(1973)]). Incisalia niphon (l.r. Nebr. 1894
Barber [1894], l.r. Iowa 1914 Berry [1914], three recent records Ill. 1957-68 Downey & Irwin [1974]).
30 Increasing or Decreasing Depending on Particular Refugia Factors--too much local detail to be useful
here. See Table II for taxa of butterflies feeding on forest plants wherever or whyever they grow.

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[6] Trinomens are used only where distinction has particular ecological significance; generic name is abbreviated after first use in each ecological community entry; verfications by author noted either as in particular literature cited, otherwise in person by author unless otherwise cited; parentheses and brackets used in respective subordination within context of statement.

[7] including altercations from resulting margins or refugia; therefore including some gains or gain/loss phenomena due to replacement vegetations.

ADDENDUM: The following data from McCabe and Post (1977) indicates: Euphyes dion (o.r. North Dakota [=N.D.] once since 1960, slough refuge). Hesperia dacotae (all distribution areas, N.D., endangered, only one productive as of 1977). Atrytone arogos (endangered, N.D., haying increased adult niche requirements). Wallengrenia egeremet (southeast ND only, rare, in oak-related water margins). Polites origines (o.r. N.D. 1972 [one other not listed]). Hesperia ottoe (very rare, N.D. true-prairie relicts in badlands only, l.r. 1961). Yvretta rhesus (o.r. N.D. 1961). Carterocephalus palemon (rare, N.D., north-central relict Canadian zone forest). Pholisora libya (o.r. N.D. undated and 1973). Pyrgus scriptura (o.r. N.D. prior 1973). Erynnis persius (o.r. N.D. 1973 due to demise of N.D. aspen). Polygonia satyrus, zephyrus (rare, N.D., in badlands). Oeneis alberta (rare, north-central Canadian zone related grassland). Erebia discoidalis (rare, north N.D., bog refugia).

ORDO TRICHOPTERA ET HOMO INSAPIENTS[1]

L. Botosaneanu

Institut voor Taxonomische Zoologie
Zoologisch Museum
Universiteit van Amsterdam
Amsterdam DH 1018, Netherlands

Abstract

Threats to Trichoptera in crenal, rhithral, potamal, and limnal life zones are reviewed, with particular focus given to European case studies. Despite recent gains in conservation research on these aquatic insects, their habitats appear to be increasingly threatened, and have already been destroyed in many instances.

Introduction

With changing patterns of agricultural and recreational water use, threats to Trichoptera (caddisfly) habitats have become increasingly more acute. Although there are huge gaps in the available knowledge, I would like to briefly summarize here threats on a habitat-by-habitat basis, covering the crenal (spring), rhithral (stream), potamal (riverine), and limnal (lake) habitats. The information in this paper comes both from the literature, and, especially, from unpublished observations provided by colleagues.

Crenal Habitats

Springs are often isolated, small, and highly vulnerable. Threats to springs in low-lying areas are particularly serious. For example, on the west banks of the Dead Sea are a few fresh and/or brackish water springs which are populated by a remarkable trichopteran fauna (Botosaneanu, 1973), including some endemics and others with scattered, disjunct distributions (*Hydroptila hirra, H. adana, Ithytrichia dovporiana, Chimarra lejea, Tinodes negevianus, Setodes alalus*). Recreational developments are encroaching on these springs, notably those at Ein Feshkha. Some years ago I helped save the springs at Corbii Ciungi, situated at 100 m. elevation in the agricultural plain of Valachia, Romania (Botosaneanu and Negrea, 1961), springs that were home to relictual populations of *Ernodes articularis, Adicella filicornis, Lype reducta, Lithax obscurus,* and *Notidobia ciliaris.* The only Romanian locality for *Plectrocnemia conspersa* is the source of the little Casimcea stream in Dobroudja, and this habitat may now be destroyed; in Provence, in the Crau, is another group of springs with a diverse trichopteran fauna threatened by habitat alteration (incl. *Agapetus cravensis* and *Hydroptila giudicellorum*).

At middle elevations in Europe the situation for crenal habitats is similar, though it is perhaps better at the higher elevations (Moretti and Cianficconi, 1975) The springs of Mt. Pentadactylos (Cyprus) have been either bricked up or channeled during the last 30 years, resulting in the loss of most of the native fauna, including Trichoptera. In the Appenine chain, progressive channeling of springs represents a serious danger to endemic crenobionts (e.g., the genus *Drusus*).

Rhithral Habitats

European stream habitats are generally in good shape in the alpine countries, but in large populated valleys the watercourses are deteriorating rapidly. In the Isere at Grenoble in 1946-1947, a thriving trichopteran fauna existed; in 1957, the larvae of *Rhyacophila dorsalis* and *Allogamus auricollis* were still extant, but by 1960 only *R. dorsalis* was found (Vaillant, 1970). Chemical pollution is to blame here, eliminating the fauna first from Grenoble, through to upstream areas. Streams in Jutland, Denmark, have become among the most polluted in the world due to the installation of trout farms which dump wastes into the watercourses (Nielsen, 1976a, 1976b). Nielsen records almost total destruction of the native fauna, including the trichopterans *Oligoplectrum maculatum, Ecclisopteryx dalecarlica,* and *Hydropsyche angustipennis.* Ross (1944) reports parallel declines in rhithral habitats in Illinois as a result of agriculture. On some Greek islands, H. Malicky (in litt.) considers that the use of insecticides could threaten the existence of species such as *Tinodes megalopompos, T. peterressli,* and *Adicella dionisos* (restricted to 3-4 streams only). On the Isla of Pinos, south of Cuba, and in Puerto Rico, some streams have also lost their fauna through haphazard application of insecticides in citrus fruit plantations (Botosaneanu, 1979; Flint, 1964).

One factor considered by some authors to be of primary importance in the degradation of streams is deforestation of the banks, and loss of riparian vegetation. Edington and Hildrew (1973) cite the replacement of *Diplectrona felix* by *Hydropsyche* under such conditions in the streams of Northumberland, and Morse (1976) discusses the importance of bank deforestation in South Carolina streams. In Haiti I was very surprised to catch only hydroptilids in the beautiful mountain watercourses, while similar streams in the wooded mountains of eastern Cuba had a rich fauna — likely the result of Haiti's deforestation.

Potamal Habitats

The status of trichopteran habitat alteration is probably most perilous in the potamal of densely populated and industrial regions, and there are only fragmentary data, documentable case studies being rare. In central Europe, Novak (1977) compared his recent surveys to those of Klapalek between the 19th and 20th centuries. Klapalek recorded 37 species of Trichoptera in the Ltava at Prague, whereas Novak recorded only 16; Klapalek recorded 33 in the Elbe, Novak only 19. The Upper Rhone (between Schaffhausen and Basle) supported at least 24 trichopterans at the end of the 19th century (Ris, 1896), but the current

[1]This article is a condensed translation of a paper presented at the Third International Symposium on Trichoptera (Perugia, 1980).

status of many of the species remains unclear. The late 19th century trichopteran fauna in the Rhine is not known (though there probably were some 40 species); only *Hydropsyche contubernalis* survives there now in great numbers (W. Wichard, pers. comm.). Similarly, *H. tobiasi* was abundant in the German Rhine at the beginning of this century but has not been seen since (H. Malicky, pers. comm.). Few comparative data exist for North American rivers. The Rock River in Illinois was already fairly polluted by the 1940s, and is now seriously affected by industrialization; the most abundant species in collections from 1924-1927 (*Athripsodes mentieus*) was completely absent during 1971-1972, having been replaced by another species (*A. transversus*) very rare in the early collections.

The importance of river areas and flood plains for the maintenance of much of the fauna is clear for European rivers. Dumont and Rivier (CTGREF, Aix en Provence) record only three species in the lower Rhone near Donzere, where the river is a canal; in contrast, in the Vieux-Rhone there are 16 species, and the influence of these waters is still felt at the downstream confluence of the canal and river. The destruction of the flood plains in the lower Danube no doubt has had disastrous consequences for the associated fauna.

Limnal Habitats

The limnal encompass lakes, marshes, and a variety of temporary habitats having standing water. Many eastern European populations of Trichoptera living in temporary bodies of water and marshes are disappearing without having been studied at all, and these are among the highest priorities in the region (Hiley, 1978, discusses the problem in the context of 11 species of *Limnephilus* and *Grammotaulis* found in England; Mey and Tietze, 1979, have been able to examine the effects of atmospheric pollutants in industrialized East Germany on Trichoptera living in stagnant water). A comparable situation exists in the Luleh marshes in Israel, where a still incompletely known fauna (Botosaneanu, 1916) may now be entirely destroyed.

As with potamal habitats, in the Bohemian lakes, Novak (1977) reports that several species common at the time of Klapalek have not been found since or have become rare. At the conclusion of a well documented study, Ujhelyr (1971) concluded that "the Trichoptera fauna of Lake Balaton whose representatives belong to the above family (Leptoceridae: esp. *Athripsodes* and *Oecetis*) since 1966 have almost completely disappeared." Resh (1976), working on *Athripsodes* in Lake Erie, showed that four species (*A. erullus, erraticus, saccus, submacula*) had been lost entirely from the lake from the 1930s through the 1970s, another five more tolerant *Athripsodes* had survived, but in much smaller populations. In Tasmania, conservationists struggling to save Lake Pedder from flooding by a hydroelectric power project may have been unable to save its remarkable fauna, including three Endemics (*Archaeophylax vernalis, Taskiria mccubbini, Taskiropsyche lacustris*) as well as the hydrobiosine *Austrochorema complexa* and the triplectidine *Westriplectes pedderensis* (Neboiss, 1977).

Discussion

Despite the generally pessimistic reports outlined above, reports of extinctions of whole taxa of Trichoptera are thankfully rare. Nielsen (1976a, 1976b) believes that two subspecies of *Apatania muliebris* which lived in single populations in two Danish springs can now be considered extinct. In this instance, the reasons may lie in habitat alteration, overcollecting, or (more likely) both. Among the more enigmatic and/or perilous current situations in Europe are:

1. *Hydropsyche fulvipes:* recorded from Belgium by a single male collected at Spa over a century ago (Marlier, pers comm.); known in Rumania from one springs habitat badly affected by drainage of the Danube flood plain; recorded as rare from England, like other localized British *Hydropsyche,* including *H. saxonica* in Oxford and *H. exocellata* and *H. bulgaromanorum* in the Thames, appear to have suffered similar fates.
2. *Platyphylax frauenfeldi:* known recently from only two Austrian specimens; but taken during the 19th century at Vienna, in the Mur, in the Alps of Styria and Italy, apparently only in large rivers (Malicky, 1975).
3. *Hydropsyche ornatula:* recorded from Romania by a single male collected in Transylvania in 1922 (Botosaneanu and Schneider, 1978); perhaps it and certainly many other species have vanished from large Bohemian rivers (Novak, 1977).
4. *Leptocerus lusitanicus:* once common in the Thames, between Oxford and Reading, is now very localized; the habitat of the aquatic stages (submerged *Salix* roots) are disappearing due to recreational activities, the species surviving only in the non-navigable portions of the river.

To my knowledge, there have only been two attempts to draw up lists of threatened Trichoptera for particular geographic areas. Wichard (1979) published a "Red List of Threatened Trichoptera in Land Nordrhein Westfalen," in which 5 species were considered in danger of extinction, 13 threatened, and 24 vulnerable (these 42 species represent about one-fourth of those known in the region). In North America, the list published by the First South Carolina Endangered Species Symposium (1976) considered one species (*Rhyacophila appalachia*) to be endangered at the national level, with another 25 species being rare and/or localized in South Carolina.

Sometimes, however, the activities of man can have a positive effect on Trichoptera, as noted on occasion above. Organic pollution of bodies of water usually favors the proliferation of species which feed by filter nets, but this is virtually always at the expense of the rest of the fauna. For example, Dumont and Rivier (CTGREF, Aix en Provence) collected comparable samples and found only 32 larvae of the limnephilid *Allogamus auricollis* in the Onde (an oligotrophic stream), 1560 larvae in the Gyr (a strongly organically polluted tributary of the Durance), and 14500 larvae further downstream in the Durance. There is also a tendency for opportunistic species to colonize habitats altered by man (the only trichopteran I known from Malta lives in irrigation canals, and in Dobroudja, several taxa colonized irrigation canals when their original springs were destroyed). Moretti and Cianficconi (1975) mention the colonization of new Spring habitats created by human activities in the Appenines, and Malicky (pers. comm.) notes that certain streams in the Greek islands with the richest fauna are those whose original vegetation has been variously disturbed.

We must concern ourselves with the fate of our insects and their habitats. Protecting isolated species by law is not necessarily effective when economic factors are involved (see Morse, 1976). What must be done is to choose with care for protected reserves those habitats which are still intact, which are in the most vulnerable regions, and which have the greatest variety of conditions and species diversities. We must also try to assemble as much scientific data, specimen material, and related written documentation to aid in the cause, for it would be sad to be left as cohabitants on this earth with only insect species such as the cockroach and Colorado Potato beetle.

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The Decline of *Parnassius apollo* (L.) Habitat in Poland (Lepidoptera: Papilionidae)

Jerzy S. Dabrowski
ul. Grabowskiego 8/4
31-126 Krakow, Poland

During the last century, *Parnassius apollo* (L.) was a frequent inhabitant of the Sudetes and Carpathian Mountains in Poland. Today the butterfly appears to be absent in the Sudetes, and is no longer found in many of its former haunts in the Carpathians (Fig. 1). This note documents the loss of *P. apollo* and its habitat in these mountain regions.

The rapid decline of *P. apollo* is evident from collecting records. For example, in 1946 in the Pieniny Mountains, the butterfly was known from 15 stations; in 1977, it was still extant in only one. This remaining station, in the vicinity of Three Crowns Mountain, is also presently threatened by habitat loss. In the Tatra Mountains during the same time period, *P. apollo* was lost from 30 of 34 stations within the boundaries of Tatra National Park, despite certain conservation measures (Fig. 2).

Recently, the Polish Academy of Sciences elaborated plans for preserving the remaining populations of *P. apollo* in Poland (under the Commission "Man and Environment"; see also Dabrowski, 1975, *Atala* 3:4-5 for further discussion). The suggested steps for recovery include: securing areas with larger concentration of the larval foodplant, *Sedum fabaria* (Koch); and preserving the coombs and glades which are a flower supply for the adult butterflies. There is less danger now from sheep grazing because of the removal of pastures in parks such as Tatra. The main tourist tracks are also distant from the stations.

Though few in numbers, the remaining stations of *P. apollo* in Poland show healthy activity in good years. Timely attempts at active preservation should therefore help the survival of this beautiful butterfly.

1

Figure 1. Distribution of *Parnassius apollo* in Poland, as of 1978.

2

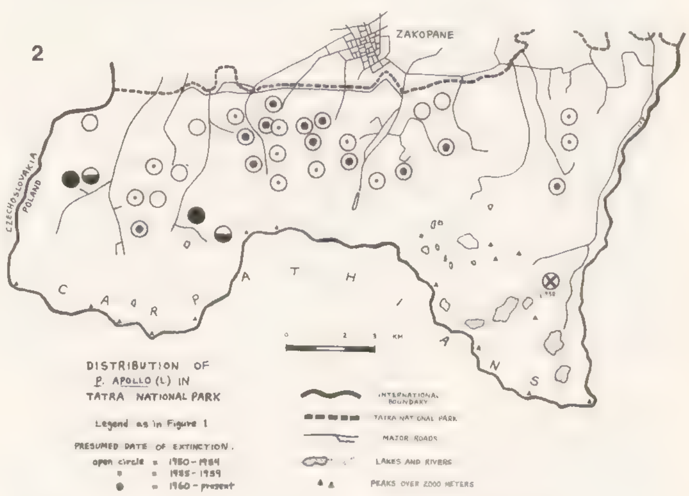

Figure 2. Distribution of *Parnassius apollo* populations within the boundaries of Tatra National Park, as of 1978.

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Please include illustrations if appropriate. Figures should be consecutively numbered in Arabic numerals. Hand-drawn figures should be rendered in black ink on good quality white paper. They may be larger than final reproduced size. Black and white glossy photographs may also be submitted. These and artwork will be returned after publication if accompanied by return postage. Figure captions should be typed, double-spaced, on a separate sheet, and the number of the figure lightly pencilled on the back of each drawing or photograph. A sketch map should be included as a figure with all articles or notes dealing in a major way with a specific region or arthropod habitat.

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EDITORIAL NOTE 1

COVER

Adult and immature stages of the South American swallowtail, *Parides ascanius*, on its native foodplant *Aristolochia macroura*. Clockwise from lower left are: two eggs, a first and second instar larva, an ovipositing adult female, and a fifth instar larva. Pen and ink drawing by Keith S. Brown, Jr. See the lead article in this volume.